

THE INDEPENDENT GUIDE TO IBM PERSONAL COMPUTERS

SPECIAL
NETWORK ISSUE



Volume 4 Number 3

\$2.95

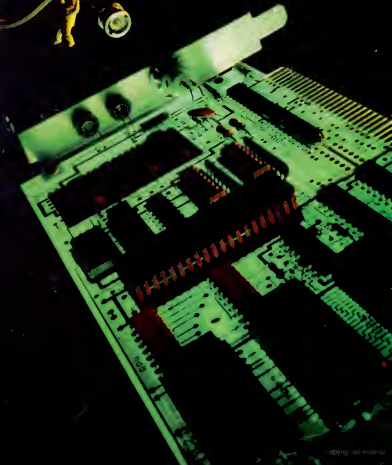
February 5, 1985

Networks Challenge Space and Time

**IBM's LAN:
Chairman of
The Boards**

**13 Networks Put
It On The Line:
3Com EtherSeries
Fox 10-NET
AST-PCnet II
Corvus Omnishare
Davong Multilink
Nestar PLAN 3000
Novell NetWare/S
Orchid PCnet
Quadnet VI
Quadnet IX
TeleVideo PM/16
Ungermann-Bass
Net/One
XComp X-Net**

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this page.



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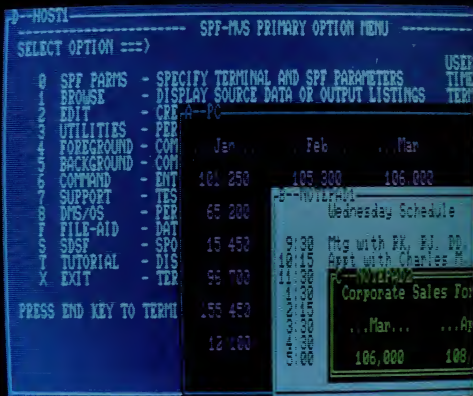
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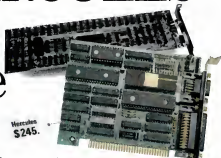
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Hercules Color Card		*		*	*	*	*
Hercules Graphics Card	*		*	*			*
IBM Mono Card	*		*				*
IBM Color Card		*			*	*	

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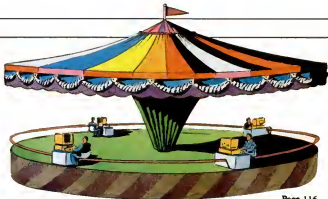
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Address: Hercules, 2550 Ninth St., Berkeley, CA 94710 Ph: 415 540-6800 Telex: 754063 **Foreign distributors:** Compuserve/Canada; Reflex/ U.K.; Computer 2000/W. Germany; Edisoft/France; Imagingnet/Australia; Holland Info Products/Holland; Data Team/Scandinavia.
Trademark/Owners: Hercules, Graphics Pak/Hercules Computer Technology; IBM, AT/ International Business Machines. **Notes:** (1) An adapter is supplied for computer video. (2) The IBM Color/Graphics Monitor Adapter must be removed from the *Portable* before the Hercules Color Card is installed. (3) Model GB01 or later. (4) Based on the list price as of 7.1.84 for the IBM Color/Graphics Monitor Adapter.



The Independent Guide to
IBM Personal Computers

VOLUME 4 NUMBER 3
FEBRUARY 5, 1985



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COVER STORIES

LOCAL AREA NETWORKS 114

NETWORK INTRODUCTION

The Lay of the LANs 116

Frank J. Derfler, Jr./Here's what's available in local area networks. You'll learn what you should know before you jump on the LAN bandwagon. Our glossary will help you decipher LAN terminology.

Networks at Your Service 125

Nat Goldhaber and Winn L. Rosch/The network server, a special computer that handles the network's commands and functions, determines the speed, security, and convenience of the entire network.

The Novell Solution 131

Robert Cowart and Steve Rosenthal/The leader of the LAN software pack for PCs, Novell's NetWare operating system gives you a safety net for your files so you can relax in a shared environment.

IBM PC NETWORK

An Inside Look at IBM's LAN 136

Sammons & Associates/IBM's new LAN for PCs allows you to network from 9 to 72 PCs, send messages between PCs, and share expensive peripherals.

Looking Ahead at IBM's LAN

Software 144

Peter Lisker and Bill Machrone/The prerelease version of IBM's software for the IBM PC network looks like a leader in the LAN market because of its overall reliability and ease of use.

BENCHMARKS

Benchmarks for Network

Ratings 152

Robert Cowart and Peter Feldmann/The purpose of benchmark testing is to measure a system's speed and capacity. To benchmark the networks reviewed in this issue, we've simulated three common multi-PC office environments.

LAN Speed Trials 168

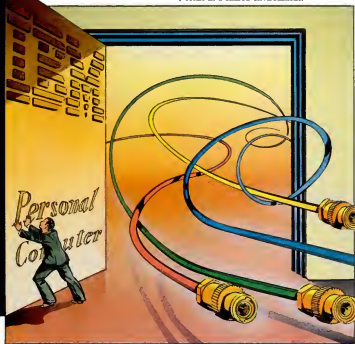
John Dickinson/Find the right network for your application with the help of these charts, tables, and graphs illustrating the results of the 13 networks' benchmark tests. Highlights of the individual networks are displayed in a special loon chart.

NETWORK SURVEY

Battle of the Network Stars 178

We review and compare the 13 networks listed below and examine network performance, ease of use, and overall cost.

3Com EtherSeries, Fox 10-NET, AST-PCnet II, Corvus Omnishare, Davong Multilink, Nestar PLAN 3000, Novell NetWare/S, Orchid PCnet, Quadnet VI, Quadnet IX, TeleVideo FM/16, Ungermann-Bass Net/One, XComp X-Net





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PRO COLUMNS

PROGRAMMING

Try a Door, Not a Window 273

John Dickinson/DOORS allows you to use your color and monochrome displays together as coordinated windows and thus enables you to display more information at once.

BUSINESS

Real Estate Returns 287

Bill Alvernaz/Real estate offices now have their pick of quality software performers. *EZ-RE Investor* and *DataBroker* are two programs that can help you evaluate investment options and keep multiple listings in order.

MEDICINE

Pharmaceutical Riches On-Line 291

Bernard Friedman, M.D./Knowledge Index, a less-expensive subset of *Dialog*, provides access to eight on-line databases, some of which contain valuable information for medical professionals. It also has a real gem of a full-text drug information database.

LAW

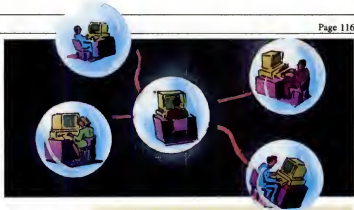
Legal Equalizers 299

Thorne Harris/PC Law and *Advanced Legal Software* are two programs that help relieve the tedium of running the financial side of office management for small law firms, and they can do the work of the support staff that only larger firms can afford to hire.

TELECOMMUNICATIONS

Remote Access with CTTY 337

Alfred Glossbrenner/Although it is little-known, the CTTY command is hardly useless. With this command, you will be able to run your PC from another computer's console. One benefit is that you'll never miss a deadline or appointment again.



DEPARTMENTS

WHAT'S INSIDE 15**PC NEWS 33**

Twelve pages of up-to-the-minute reports, interviews, minireviews, and useful tips, along with entertaining tales and fables from the computer community.

**FROM THE EDITOR'S SCREEN****More Power to You 81**

Bill Machrone/Micros and minis are locked in competition. Will networking for PCs help decide the issue?

LETTERS TO PC 93**THE NORTON CHRONICLES****Software for One and All 103**

Peter Norton/In software and computers, not all things are equal, or compatible.

USER-TO-USER 279

Paul Somerson/PC owners share their tips and short programs.

PC TUTOR 283

Mark Zachmann/PC answers readers' technical and nontechnical questions about personal computing.

PC:MART 297**CLUB NEWS 303**

Jane Mintzer/Listings of dozens of IBM PC users groups.

NEW ON THE MARKET 307

David Obregon/The latest in hardware, software, accessories, publications, and services for your PC.

PC BLUEBOOK 314

A quick-reference guide for PC owners and soon-to-be owners.

PRODUCT INDEX 333**INDEX TO ADVERTISERS 341****COMING UP****PC Tech Journal 336****PC Magazine 351**

Cover Photograph: Peter Angelo Simon

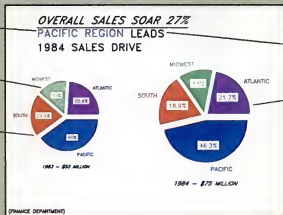
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(Millions of \$)

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Sales	86.4	121.0	144.0	163.6	182.0
Net Income	5.9	8.8	11.4	13.4	15.7
ROI (%)	6.9	7.3	7.9	8.2	8.6
Mkt. Share	48%	61%	65%	71%	78%

Capital expenditure required: \$5 Million
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(Source: Annual Report)

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Net Income	5.9	8.8	11.4	13.4	15.7
ROI (%)	6.9	7.3	7.9	8.2	8.6
Mkt. Share	48%	61%	65%	71%	78%

Summaries

Exhibits

Net Income	5.9	8.8	11.4	13.4	15.7
ROI (%)	6.9	7.3	7.9	8.2	8.6
Mkt. Share	48%	61%	65%	71%	78%

Exhibits

Schedules

Net Income	5.9	8.8	11.4	13.4	15.7
ROI (%)	6.9	7.3	7.9	8.2	8.6
Mkt. Share	48%	61%	65%	71%	78%

Schedules

Tables

Net Income	5.9	8.8	11.4	13.4	15.7
ROI (%)	6.9	7.3	7.9	8.2	8.6
Mkt. Share	48%	61%	65%	71%	78%

Tables

NEW PRODUCT PROPOSAL
For the introduction of the
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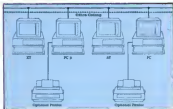


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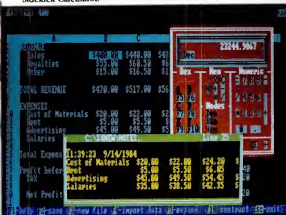
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What's Inside

Producing an issue of PC Magazine can seem like one long string of editorial problems, but it can also mean long, leisurely lunches spent coloring with crayons.

As readers of this column may well imagine, writing What's Inside every 2 weeks can be a lot of fun. Every other piece of prose in *PC Magazine* must be checked, double-checked, and sometimes even triple-checked (and still, our readers sometimes catch us in mistakes). On the other hand, the author of What's Inside can indulge in occasional harmless exaggerations without too much soul-searching.

However, sometimes it can be a very depressing chore as well. As each issue brings with it a new rundown of the latest in hardware or software, it also brings a host of editorial problems—all of which usually get detailed right here.

For example, take this issue's benchmarked reviews of 13 local area networks—hardware-software combinations that enable separate microcomputers to communicate with one another. Since the project started, staff members have been sidling up to me and saying, "Boy, I can't wait until you write What's Inside for the networks issue. Now, *there's* a cover story that drove everyone berserk!" And executive editor Mike Edelhart, when asked to succinctly describe the magazine's contents, growled, "It's the issue that ate up and spat out the most human beings."

But do you really want to know how Edelhart, associate editor Stephanie



Stallings, and free-lancer John Dickinson had to begin the project from scratch about 2 weeks before the final manuscript deadline? Or what technical assistant Mike O'Conne and contributing editor Robin Webster looked like after they had spent 48 straight hours putting together networks? Or how various reviewers came wandering out of the testing rooms like a group of shell-shocked veterans? Do you really want to hear what Stallings said when she found out that we had no phone service the day that Glenn Hart's review was supposed to arrive via modem?

Of course you don't. I'm sure that you have your own very important problems

and don't need to be burdened with ours. Besides, it's simply too gruesome to recount.

Crayola Quintet

Instead, I'll let you in on a well-kept secret: how we produce the cover lines and article titles for each issue.

Cover lines are all those clever phrases on the magazine's cover that are meant to lure you into buying the magazine (if you don't have a subscription), and titles are meant to lure you into reading the articles once an issue is in your hands. Do you suppose that the top editors of the magazine sit together in solemn conclave to produce these witty sayings?

Of course not.

For example, to create the titles for this issue, a contingent of staffers including Stallings, Dickinson, assistant managing editor Posy Gering, senior copy editor Jean Atelsek, and assistant editor Fredric Paul found their way to a local restaurant called the Brickwork Café, a few blocks from *PC's* offices. Now, the Brickwork holds a particular attraction for members of the *PC* staff, especially those of us with pretensions to great artistic talent—it has white paper tablecloths and crayons with which customers can scribble to their hearts' content.

Under the influence of food, drink, and Crayolas, the quintet spent a happy

WHAT'S INSIDE

couple of hours producing the large-sized words that now decorate the magazine. Rumor has it that Paul, especially, came through with flying colors. We do

know for sure, however, that, whatever profundities these working lunches produce, they are usually accompanied by a strange and inexplicable reluctance on

the part of the participants to return to the office.

What's in a Theme?

Astute readers may have noticed that this is the second "theme" issue we've had recently, in which the entire magazine is dedicated to a single cover story—the first was our "printer" issue (Volume 3 Number 23). In the case of the printer issue, the coverage of the theme was entirely and efficiently planned. In the case of the magazine you're now holding, it was not.

Picture this: It's a lovely, sunny day in the offices of PC. All the copy deadlines for Volume 4 Number 3 have been met, and most of the editors are sitting back, comfortably contemplating a job well done and little suspecting that in a few short moments their world is going to fall apart.

In a small office in the art department, art director Gerard Kunkel sits and counts the number of manuscript pages prepared for the magazine. A horrible suspicion grows in his mind: too many features may have been slated for the magazine.

He counts. He counts again. He stands up, goes into the office of assistant managing editor Posy Gering, and announces, "Remember when we thought that we may not have enough articles for this issue?"

"Yes," she answers. "So?"

"Well, I just counted the pages for the magazine. The network articles *alone* account for 40 pages *more* than we have available for our *entire* features section!"

Gering immediately went into action. After about an hour of rather frantic conferences involving most of the editorial staff, all the noncover features, several of the related network articles, and (with the cooperation of executive editor Paul Somerson) a few of the columns were dropped from the issue. The result? A still-formidable and very special package of features and reviews. ■

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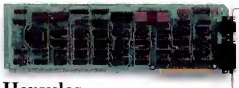
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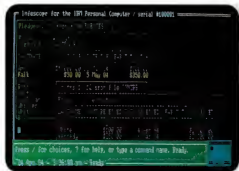
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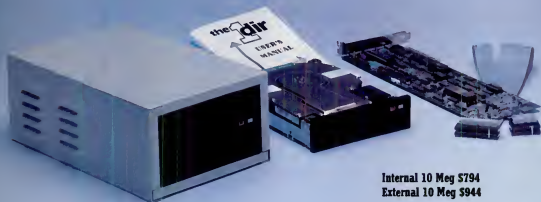
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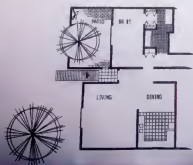
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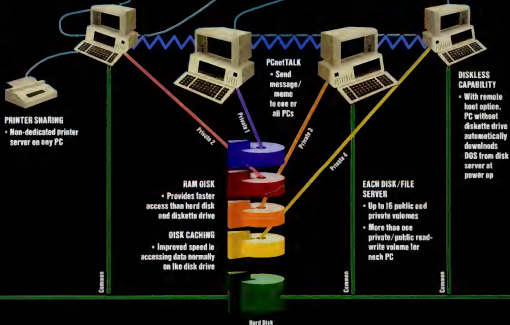
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LANews

FROM THE EDITORS OF PC

FEBRUARY 5, 1985

Intel Hits With New Chip

The network ante's lowered with the 82588 chip, and things may never be the same again.

BY BILL MACHRONE

NEW YORK—Just when you thought it was safe to get into networking in a big way, Intel has announced a revolutionary new integrated circuit that threatens to knock the bottom out of the market.

Chip builder to the world, Intel has key circuits on nearly everyone's network cards already. But resting on its laurels is not the way that a big semiconductor manufacturer gets ahead in this business. Stamping out silicon everyone wants at a fraction of the going price is.

Intel's current pride and joy, the 82586 chip, resides on such prestigious network cards as those from IBM and Ungermann-Bass. But these products cost upwards of \$700 per connection, too much for anything but applications that really demand networking. Intel's new chip, the 82588, provides only a fifth of the 82586's maximum performance, but at \$250 or less per connection. And for most office applications, low price is far more important than blazing speed.

The 82588's favorite brand of networking is CSMA/CD (carrier sense multiple access/collision detection) on twisted-pair wiring. It is equally capable of broadband networking, as with IBM's PC Network, but you must add the (high) cost of an RF modem. Twisted pair is the

darling of office automation planners because buildings are already full of it—the phone system wiring. Jamming data across the copper at 2 megabits per second feels just like heaven.

Low Priced Chip

The chip itself is initially priced at just \$45, with prices scheduled to fall into the \$20 range within the next 2 to 3 years. Costing one third less than comparable Ethernet chips, the 82588 will likely be

the chip of choice for all but the highest-performance network applications. It is remarkably self-contained, requiring only a bus interface, clock, and line drivers for a complete PC interface card. These chips take up less than 12 square inches of board space, so manufacturers of compatibles may be sorely tempted to include networking right on the motherboard.

Third-party manufacturers will likely include networking on multifunction cards, as Or-

chid's Blossom does. Intel certainly won't mind supplying chips to the fray. As Intel product marketer Bob Dahlberg wryly explains, "We're in the business of making bullets."

Mark Stieglitz, director of LAN marketing for AST, agrees this is an opportunity to put networking on motherboards or multifunction cards. "The advent of low-cost networking and simultaneous standardization through DOS 3.1 enables users

(continued on next page)

ANALYSIS

WordStar 2000: MicroPro Odyssey

The more WordStar changes, the more MicroPro hopes it stays Number One.

BY CRAIG STINSON

SAN FRANCISCO—The "invites" to the press and the banners adorning the hall proclaimed, "The Rumor Is True..." referring to the fact that MicroPro International has indeed been devoting much of its human and financial resources over the last year and a half to the development of a suc-

cessor to WordStar. That product, dubbed WordStar 2000, emerged from semisecrecy at a press conference here on October 31.

But the message that MicroPro executives underscored at the press conference again and again was this: "We've heard your complaints, and we've

paid attention to them."

Almost since its birth 4 years ago, MicroPro has had a seemingly unshakable reputation for three things: arrogant indifference to user feedback (MicroPro's classic reply to questions about WordStar was, "Call your dealer"); possession of one of the more difficult-to-use word processors on the market; and possession of the most powerful word processor available.

And, while the press conference's nominal purpose was to unveil the new WordStar, the event also gave the company an opportunity to declare a divorce from certain aspects of its past.

Not only have MicroPro representatives been staying on the

(continued on page 35)

New Chip (continued)

to separate networking into two decisions: whether to network at all, and what kind of hardware to use. Today those factors are inseparable.

While AST doesn't yet have a commitment to the 588, it has developed a custom gate array for its PCnet II board that reduces space and cost. However, AST officials readily acknowledge that this new Intel chip will take up even less space and provide an even higher level of integration.

Computing's Future

Why is a product-oriented magazine such as *PC* telling you about chips at all? It is far easier to read chips than tea leaves or goat entrails to determine the future of the computer business. A new chip typically begins to appear in products anywhere from 6 to 18 months after its introduction. Groups of chips work together synergistically to make a computing whole that is greater than the sum of its parts.

Playing what-if with unreleased or sample semiconductors is a favorite pastime of industry analysts. And rightfully so, because the time spent is usually productive and the predictions are reasonably accurate. This particular integrated circuit may well be the critical ingredient that busts networking wide open. After all, it promises performance on par with existing products at a fraction of the cost. And, speaking of synergy, the recent introduction of DOS 3.1 gives the industry a long-awaited standard for network-based application programs. The combination, spiced with a higher awareness of office automation, will bring hungry users to the networking table at last.

Passing the Chips

The other great promise of networking, the sharing of expensive resources, has proven to be resoundingly hollow, done in by the industry's implacable cost-performance curves. Why share somebody else's crummy XT when you can add a local 10 megabytes of your very own for only a little more than the cost of 9 network cards? Top-of-the-



The board above uses the 82588 chip to connect a PC with a STARLAN network.

line printers are still arguable, since they cost as much as most personal computers. But do you really believe that you can suc-

cessfully print properly aligned business letters on a printer you can't even see? With the improvement of low-end printers,

printer sharing won't even be an issue a year from now.

What's left? The same thing that caused the world to computerize right from the start: information management. Electronic mail, shared databases, expert systems, and calendaring/messaging will become common in advanced offices everywhere. These processes are vital to increasing office productivity and networking is vital to implementing them. Chips such as Intel's 82588 are vital to low-cost networking. ■

Computer Channel Aims To Become TV Guide

Television programming gets a new meaning as Discovery tries to be an the MTV for PCs.

BY TONY POMPLI

LOS ANGELES—An "umbilical cord to the nervous system of the computer industry," that is how Glen Taylor, president of Discovery Computer Network and creator of the Financial News Network (FNN), describes Discovery, his new computer cable television channel.

Scheduled to go on the air February 10, Discovery will provide cable television subscribers with a channel that is devoted entirely to computers and the computer industry. Four hours of original programming will be rebroadcast six times daily, 7 days a week, and will encompass reviews of hardware and software programs that range from games to business applications, interviews with people involved in the industry, news, and stock market updates.

In addition, the Discovery channel will transmit digital information on the same cable channel via Data Link, an optional database service. Data Link subscribers could then receive software and other information directly into their computers by using a special Discovery decoder/modem device.

At start-up, Taylor says Data Link will provide public domain

software. Later, he anticipates transmitting demo software provided by commercial developers to allow potential users to try products before purchasing them. The decoder uses technology that gives the subscriber a specific code number, which is similar to a mailbox address. For an additional fee, Data Link users can then send electronic mail to other Data Link users on the network. The decoder will cost \$200, and the service will run \$20 per month.

Free TV

Discovery is offering the Network free of charge to multi-system operators (MSOs), the large cable television operators who generally oversee the smaller local, community operations. Therefore, its revenues will be entirely dependent on advertising, Data Link subscriptions, and decoder sales.

"According to Future Computing, 50 percent of all cable TV subscribers also have a computer," says Taylor. "We anticipate placing our decoder in 10 percent of the \$0,000 cable homes. That's \$1 million a month from Data Link alone." With \$15 million to \$20 million in anticipated start-up costs,

Taylor estimates Discovery will be reporting \$1 billion in revenues by 1990.

The track record for cable-oriented database services is discouraging, as underscored by the fall of the experimental, interactive Qube system and, more recently, the Nabu service, a cable service that allowed users to download software to their computers. But, telecommunications consultant Richard Loftus, who is president of Trident Communications Group and former president of Scripps-Howard Cable Television Division, is more optimistic. "No one questions the ability of cable TV to provide data-based systems, and it is seen as an extraordinary opportunity. It's a question of what does the market want, what is it willing to pay, and what is the method of getting it to the marketplace."

Video Market

As for Discovery's proposed Data Link products, such as public domain software and demo software, Loftus says, "There is a marketplace for software—games, business, and other types."

Approximately 5 million homes have already been signed up through the MSOs, and Taylor anticipates a total of 10 million by the end of 1985.

According to Loftus, companies will eventually come up with the formula to produce a successful database cable service. However, whether the Discovery Network is going to be one of those enterprises remains to be seen. ■

WordStar 2000 (continued) line recently when called about *WordStar*, they've actually been looking for feedback. According to *WordStar 2000* product manager Leigh Marriner, the company conducted extensive interviews with word processor users at all levels of the corporate totem pole and incorporated what was learned into the new product.

Change of Attitude

As for *WordStar*'s hard-to-learn, hard-to-use reputation, MicroPro spokespeople did not say they agreed with that charge; what they did say, though, sounded a lot more like nolo contendere than "not guilty."

"We've smarted under and resented the criticism," admitted H. Glen Haney, the company's president and chief executive officer. "But we did listen."

New and Improved

And MicroPro did take a number of steps to protect its new baby from similar brickbats: It added more menus (eliminating inline dot commands). It also simplified and streamlined the mnemonic command system, so that most—though not all—of the control-code commands actually bear some intuitive relationship to the functions they invoke.

MicroPro also provided function-key alternatives to control-code interfaces; added a context-sensitive help facility; included a screen where bold looks bold and underlined looks underlined (no more 'Bs and 'Ss, thank you); and assigned the writing of documentation, menus, help screens, and prompts to writers instead of software developers. According to Haney, "The developing technicians had nothing to do with the user interface."

Keeping Up Strength

With regard to *WordStar*'s reputation as the most powerful word processing program in the field, MicroPro signaled its intention to bolster an image it admitted was starting to fade. "We want to crowd out all the



H. Glen Haney, Micro Pro's president and CEO.

guys at the low end...and block out everybody at the high end," Haney declared.

Haney names four factors contributing to a partial eclipse of *WordStar*'s lustre over the last year: a couple of recent hardware announcements (the Macintosh and the AT); the noise level in the marketplace created by *Framework* and *Symphony*; competition from new (unspecified) low-end word processors; and the general perception that *WordStar* was outdated.

Possibly in anticipation of Apple's "computer for the rest of us" (whose success was very

much an unpredictable quantity at the time *WordStar 2000* development began) and certainly in preparation for the coming UNIX marketplace, MicroPro wrote its new product in C.

At the moment, *WordStar 2000* is available only for MS-DOS machines, but that should change in 1985. MicroPro also plans to produce versions of *WordStar 2000* translated into various European languages and into the Kanji character set for the Japanese market.

MicroPro clearly believes that *Framework*'s and *Symphony*'s ambitious integration imposes unacceptable limita-

tions on the power of their word processing modules, and that those modules are too hard to use. "We're glad to hand off the epithet of 'hard-to-use' to someone else," allowed Haney.

I'm Easy

The motto across the bottom of the *WordStar 2000* box reads "Easy word processing you'll never outgrow." Just how MicroPro intends to keep both ends of that promise emerged as one of the press conference's more interesting subthemes.

While MicroPro executives never explicitly named their competitor up north, it was clear they had spent time evaluating *Microsoft Word* and pondering its design philosophy. Some of the techniques pioneered by *Word* found their way into *WordStar 2000*—and some did not.

WordStar 2000 for example, does windows (up to three at a time). But it does them without borders (*WordStar 2000*'s windows are positioned over and under one another and are separated only by margin-and-tab rulers). *WordStar 2000* uses style sheets for print-formatting purposes, following the lead established by *Word*.

But *WordStar 2000* does not employ a mouse, putting its trust in keyboard-intensive—as opposed to mouse—interfaces. *WordStar 2000*'s salient design feature is its retention of the command-language style of its predecessor. Sure, you can cursor-point to all sorts of things in *WordStar 2000*, and you can use function keys as alternatives to control characters. But the mnemonic interface is still there for the benefit of typists who like to leave their hands in one place (and also for the million or more users already comfortable and familiar with the original *WordStar*).

Product manager Marriner said that, based on its interviews and other research, MicroPro concluded that a well-designed mnemonic command system is still the most effective form of word processing user interface. MicroPro's continuing commitment to that design philosophy positions its considerable bulk squarely against the tide. ■

Generic Electronic Mail

Travelers aren't likely to go to California's Silicon Valley to gaze at the scenery. Santa Clara county offers far more venture-capital opportunities than photo opportunities.

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—James Langdell

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So, when you're thinking of INPUT, go ahead. Use, or LPRINT or LOCATE or INKEY. But without BASIC_C, you will find that every line of code plunges you back to the C manual to figure out how to write it. Someday you will want to, but for now, BASIC_C will start you programming quickly at the state-of-the-art. You can concentrate on C's larger concepts.

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FAST-C

This Editor Finds Compile Errors

Here's how to speed up the glacial crawl of editing your program file, running the compiler, noting errors, counting lines to find them, reloading the editor, and around again.

FAST-C (via page or file) FAST-C puts errors and gets you out of the line of code which displays the error message in turn, highlights the program line which caused it, and displays the ten lines above it. FAST-C is an editor, so you can fix the error on the spot, move on to the next, or access your entire program, add new code, etc.

You also get a library of handy debugging functions which display values as you modify them, show constants beginning at a specified address in both hex and characters, and signal whenever about the error. And Fast-C file scanner which can find and search and replace using wildcards, up to 100 files at one go.

Product Code: S0250 • Our Price: \$129.95
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BTREVIEW

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If your programming still gets anywhere near the files, here's our quarter. Nothing will increase your productivity faster than handing the filing job to a sophisticated file manager.

BTReview™ is the best we have seen. It's a complete change of all file indexing, reading, writing, insertion, and deletion. It builds 22 commands right into the language you use in the form of functions you call to tell BTReview where to go. The commands create, open, and close files; delete and insert records, reorganizing vacated space, find records which exactly or most nearly match keys, walk files by ascending or descending key. BTReview's foundation is a balanced-tree indexing scheme, conceived to be the fastest search technique devised (it will find any key in a million-plus item index in four or less accesses).

BTReview comes with interfaces to C,

Pascal, BASIC, and COBOL, and the manual gives you working sample programs which demonstrate every command in all four languages. The kind of presentation which led PC World to exclaim "For those of us who have endured poorly written and inadequate manuals, this one is a pleasure to read."

BTReview has machine specifications! A single file may have up to 34 indexes. Segments of keys may be indexed. Each index can independently accept or block duplicate keys. A record length can be up to 4080 characters, an index length 256 characters. A file may be 4 billion bytes. It can even extend a file across two drives — even two hard disks!

With BTReview you are freed to think logically, the physical file is no longer of concern. Gone for good is all that time-wasting dithering with intricate file referencing schemes and sorting algorithms. Thinking should go to a higher plane.

Product Code: 50650	Our Price
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PLINK86

Overlay Linkage to Expand Your Art of the Possible

Software is becoming ever more sophisticated, which means more complex programs requiring large chunks of memory. But if you use extra memory, you count on users to have expanded RAM, and foreign sales to those who do not.

PLINK86™ is the answer. It shows how large programs into small memory. First, PLINK86 acts as an alternative to DOS language. It allows the use of separately compiled object modules in the Microsoft relocatable format. PLINK86 pulls modules together into single compiled executables. But PLINK86 overlay power is what has gained it a reputation as a miracle worker. It binds into the compiled program its overlay manager which organizes how to link modules of your large linked program between disk and memory, so that each can temporarily occupy the same memory space.

Whether an overlay manager acts on its own, needing no calls from the source program. Instead, PLINK86's straightforward overlay description language allows you to describe your overlay structure in one place in your program — a structure permitting up to 4,096 overlays stacked 32 deep. No re-compiling to re-arrange the structure!

PLINK86 can even sub-divide its linked output into multiple files for programs which must span more than one disk. And it produces a symbol map for debugging with PLINK86 Plus.

But most of all, sets you free to write the comprehensive code today's users have come to expect without sacrifices to assembly.

Product Code: 50850	Our Price
Last Price \$395.00	\$315.00

LATTICE C

The Preeminent 16-bit C Compiler

C's structured approach encourages development of tight, full-faithful programs which can be counted on to return reliable results every time. Local variables, unknown outside of functions to safeguard against collision. Extremely powerful nested expressions which produce elegant, concise code.

Lattice C™ is the unparalleled choice for program development. Byte said "the Lattice C compiler produces remarkable code, outstanding in terms of both execution speed and code compactness." After reviewing nine compilers for the PC, the PC Tech Journal unequivocally declared Lattice C "best for software development... it compiles fast and produces fast programs."

Lattice C is a full implementation of Kernighan and Ritchie, not a subset, plus extra features such as nested comments, and 38-character variable names. Lattice C runs on virtually any computer using an 8086 or 8088 microprocessor. Create your source files with any

word processor or text editor like our Private or ES/P for C and Lattice C will compile them into Intel 8086 object modules for linking with other modules by DOS Link or our Purk86.

Lattice C offers a choice of four memory models which allow the program designer to choose the right combination of efficiency and save for an application: a range between 64K end RAM capacity for program and data.

The compiler comes with a library of 100 routines which implement under MS™DOS most of the Unix-compatible standards described by Kernighan & Ritchie, a fulsome set of transcendental math and string functions. Lattice C didn't mention, and some of Unix's most useful options such as Fork, to pull another program into memory in parallel, branch to it, and return. Lattice C will also automatically sense and use the 8087 chip.

The documentation, which Byte says "sets such a high standard of excellence that others don't even come close," covers the interface to assembly language and machine dependencies. Needs 128K.

Product Code: 50100	Our Price
Last Price \$500.00	\$295.00

ES/P for C

The Next Best Thing to a C Interpreter

E/S/P for C is a language dedicated to what it knows: C. Plus a Link and a companion key and ES/P for C sets up for you a complete framework of C structure, whether it's then-ease, do-while, switches, loops, even user-defined frameworks for "main" and entire functions.

Inside these structures, ES/P for C then outlines the components to be filled in declarations, statements, etc. And when you go to fill in, say, a declaration segment, ES/P for C prompts for what's needed, shows menu of options — e.g., "int", "char", "float" — and fills in the semi-colons and curly braces for you.

To say that it will save countless keystrokes is the most trivial benefit. ES/P for C is really a powerful outline processor. It lets you enter the superstructure of an entire program in minutes, with all structures properly nested, code neatly indented, and reserved words in place. Then prompts to make sure you don't forget to fill in all the spaces between.

Now that ES/P for C has locked after syntax and punctuation, when complete time errors evaporate. And we haven't even mentioned that ES/P for C can operate on four files at once in separate windows. Also available for Pascal.

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News In Brief

More Practice Makes WordPerfect 4.0. . . Satellite Software International (SSI) released *WordPerfect 4.0*, the latest version of its word processor. (*WordPerfect 3.0* was evaluated in the word processor survey in *PC*, Volume 3 Number 17.) Among the improvements: A 100,000-word spelling dictionary (including legal and medical terms) that takes up less memory space than the old version's smaller spelling checker. You can enter a phonetic approximation of a word to find its correct spelling. The program now can generate tables of contents and indexes and automatically number paragraphs and insert outline headings.

It includes utilities to perform automatic file backup and to convert *WordStar*, *DIF*, and other files for use in *WordPerfect*. The new version now highlights marked blocks of text in reverse video, a feature absent from earlier versions.

Over 100,000 copies of *WordPerfect* have been purchased since the program was introduced in December 1982, according to Jeff Acerson, SSI's director of public relations. The word processor comes in six international versions: Danish, Finnish, French, German, Norwegian, and Spanish. Each international package includes a spelling dictionary and manual in the appropriate foreign language. Satellite Software sources report that Swedish, Dutch, and Italian versions are in preparation.

WordPerfect 4.0 requires 128K when used with DOS 2.1 or earlier, and 192K with DOS 3.0. List price for *WordPerfect 4.0* is \$495, but owners of earlier versions can obtain the updated program and manual for \$40 from Satellite Software International, 288 West Center St., Orem, UT 84057.

First Born Clone. . . Being IBM compatible is important to large and small companies alike, and so it should be no surprise that a three-person subsidiary of a Japanese company was the first to announce an IBM PC AT compatible. Or is it?

Tomcat Computer Inc.'s United States office in Los Angeles has announced a compatible version of the AT, priced 25 percent lower than IBM's. The **Tomcat 3200-AT** has an Intel 80286 microprocessor, 512K RAM (same as the PC AT), and a 1.2-megabyte floppy disk. It will sell for \$2,996. The 3200-AT also comes in a version with a 20-megabyte hard disk that will cost \$4,346 (the PC AT in the same configuration cost \$5,795).

Tomcat will soon begin making the computers in both Japan and California, but they are presently manufacturing them only in Japan, to save money on parts and labor. According to marketing manager Nobby Yoshida, "This is a major reason why we can offer lower prices for a machine that is comparable and compatible with the PC AT."

Yoshida claims that all software that does run and will run on the PC AT will also run on the 3200-AT. He also says that several software companies have already approached him about designing software for the 3200-AT. Yoshida would not release the names of these companies but expects that agreements will be announced in March or April of this year.

Yoshida expects that Tomcat's low prices will be attractive to retail distributors and VARs that take computers manufactured by other companies and install their own labels on the machine. "We will provide a favorable price over IBM's to attract people through these major distribution channels," says Yoshida. Tomcat will supply OEMs with quantities as small as eight units a month.

Tomcat expects to sell 50,000 of its PC AT clones in 1985. The company also offers IBM PC and PC/XT compatibles. More information is available from Tomcat at 548 South Spring St., #508, Los Angeles, CA 90013, (213) 689-4522.

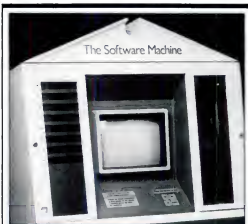
New Software Publisher

...One of the newest trends in the computer book market is for book publishers to expand into publishing software, and **Prentice-Hall**, a leading computer book publisher, has hopped onto the bandwagon.

Prentice-Hall's entry in the software publishing field will begin with three series of software programs. The *IBM PC Apprentice Personal Computer Learning Series* will offer tutorial workbooks and educational versions of popular software programs to students and general consumers. The *Profit Center* is a family of integrated accounting, word processing, and time management programs. And the *Home Software from Prentice-Hall* series consists of educational and productivity software for home computers.

Prentice-Hall also publishes business books and college textbooks. Contact Prentice-Hall, Inc., at Englewood Cliffs, NJ 07632, (201) 592-2840.

—compiled by Jane Mintzer,
with James Langdell



Chippendale Station

My eyes were caught by the roof of this electronic software distribution station, manufactured by Inventory Transfer Systems, Inc. (ITS) of Palo Alto, Calif. Did that Chippendale-style notch mean that ITS had ties with AT&T, whose new Manhattan headquarters sports a similar top?

If that were true, would ITS get discounts on long-distance calls—an expense that has bedeviled other electronic software distribution efforts? (See *PC*, Volume 3 Number 19, page 46 for a survey of that industry.)

I asked Robert Rice, vice-president of ITS, about his station's intriguing design. "No, the electronic retailing equipment won't really look like that—we'll build the machine any way a software distributor wants it." (Thus far, ITS has a contract with one distributor in the United Kingdom, Software Express.)

"We made just that one station with the notched top," Rice explained. "When people see it, they stop and say, 'What the hell is that?'—and our company sticks in their minds."

—James Langdell

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[illegible]

A Guided Tour Through The Computer Museum

The latest addition to Boston's waterfront puts computer history at your fingertips.

BY JANE MINTZER

BOSTON—There aren't any dinosaur bones in this museum. In fact, the oldest relic on display is younger than a World War II souvenir. But, nonetheless, this austere building on Boston's waterfront houses illustrations of a fascinating history: that of the computer. Technological change seems to be occurring at a breakneck rate, and The Computer Museum allows us to understand just how far we have come in such a short time.

Dr. Gwen Bell, director of The Computer Museum, says the museum serves as "both a statement of the past and a statement of the future." Recently moved from Marlboro, Mass., The Computer Museum now resides in a renovated warehouse that overlooks the Boston Harbor. Its present location offers a spacious setting for old and new treasures. Through interactive displays, videotapes, and film clips, recreations of vintage computers, and state-of-the-art machines as well, visitors view the history of computing from the 1950s through the present, with a glimpse of what's in store for the future.

The museum is divided into four main galleries (arranged in chronological order), a library, an auditorium, rooms for traveling shows and future exhibits, and a museum store.

Up the Tube

After you ride up the outside of the building in a glass-enclosed elevator, you are deposited into Gallery 1, called "The Vacuum Tube Era." Here, you are caught inside a 3,100-square-foot recreation of The Whirlwind—the first vacuum tube computer with an operational core memory. Built for the U.S. Navy, The Whirlwind



The Computer Museum in Boston offers many surprises for computer enthusiasts.

took up an entire building at MIT and was used as an early aircraft flight simulator.

Alongside a UNIVAC computer is a tape of Walter Cronkite introducing the UNIVAC to TV viewers as the computer that predicted the outcome of the Eisenhower-Stevenson race during the CBS News coverage of the 1952 presidential election. (Although UNIVAC is shy when Cronkite holds the microphone next to it and asks, "Tell us UNIVAC, who do you think will win this race?" UNIVAC correctly predicted off-screen that Eisenhower would win by a landslide.)

"The Transistor Era," in Gallery 2, features developments of mainframe computers ranging from the IBM 1401 to Digital Equipment Corporation's PDP-8, which is believed to be the first minicomputer. A film clip features the renowned supercomputer wizard Seymour Cray, as well as Control Data's 6600 supercomputer.

PC users are sure to gravitate toward Gallery 3, "The Integrated Circuit Era," because it traces the construction of a modern computer from concept to chip to finished product and explores the evolution of personal computers.

Welcome to PC

The entourage of personal computers is arranged in semi-

circle rows; the back rows serve as a cemetery that is filled with obsolete or outdated personal computers, including the Altair, the LINC, and the Apple I. The front row proudly shows off the newborns and infants: the currently used, state-of-the-art equipment. Although the museum has no IBM PC AT (it is waiting for IBM or someone else to donate one), the IBM PC-XT, a Compaq Deskpro, a Macintosh, a Hewlett-Packard 150 with a touch-screen, and a Commodore 64 are among the familiar devices on display.

High-Tech Souvenirs

After visiting the museum, you can shop in the museum store for computer books, clothing, jewelry, and other computer-related products for yourself or your favorite computer aficionado.

Bell says the museum will constantly change and expand its exhibits to keep up with new developments. "The programs you see running on the minis in the image gallery today might be available and running on the PCs tomorrow," she says.

She is confident of the museum's broad appeal to people of all ages and degrees of computer knowledge. She says the museum plans to develop "thematic galleries" to explore various areas of interest in conjunction with the Boston Computer Society.

The museum's hours are 11 a.m. to 6 p.m. on Wednesdays, Saturdays, and Sundays and from 11 a.m. to 9 p.m. on Thursdays and Fridays. It is closed on Mondays and Tuesdays. For more information, contact The Computer Museum, Museum Wharf, 300 Congress St., Boston, MA 02210, (617) 426-2800. ■

Image Is All

Moreover, you can do more than just look at these computers. Working programs are continuously running on many of the machines, including a graphics program, an instructional program, and a voice synthesizer. These participatory exhibits will change as new developments occur in the personal computer field.

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WordPerfect 4.0. Our

The process of perfecting word processing.

At SSI, we're not in the habit of resting on our laurels. Even though the overwhelmingly positive response to WordPerfect has tempted us to do just that, we just don't. Instead, we spend our time making WordPerfect even more perfect.

WordPerfect 4.0, our newest edition, is the result of all that work. With the input of users and dealers, we have added several important enhancements and features to WordPerfect, making 4.0 the most perfect WordPerfect, yet.

included in WordPerfect's base price... is a 30,000-word speller

InfoWorld Magazine

Expanded and improved.

You may not have been satisfied with WordPerfect's 30,000-word dictionary. And neither were we. So, WordPerfect 4.0 includes a new phonetic dictionary with 85,000 words (which take up less space on the disk than did 30,000 pre-



viously). Plus, the new dictionary includes a document word-count feature and the ability to search entries using any letter in the word.

this fall we can expect new WordPerfect features such as table of contents and index generation

PC Magazine

Right on time.

WordPerfect 4.0 features automatic generation of indexes and five types of tables, including table of contents. You simply mark words to appear in the desired tables, and generation is accomplished with just one keystroke.

Footnoting is a good example of WordPerfect's sensible style.

Business Computing

Sensible, but not good enough.

The same footnoting capabilities garnering much praise for WordPerfect are even more enhanced in WordPerfect 4.0. Now lengthy footnotes can span multiple pages, and footnotes can be placed either at the bottoms of pages or at the end of the document. In fact, footnotes and endnotes can both be used in a single document.

Earlier versions of WordPerfect were plagued with poorly organized documentation.

Softalk Magazine

We agree.

The documentation for WordPerfect 4.0 reflects a great deal of reorganization and improvement. Following a number of suggestions

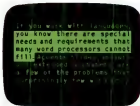


highest marks yet.

from users and after extensive testing of the new format, SSI is excited to introduce this significantly enhanced documentation package. Many new diagrams have been added and tutorials are more extensive. In addition, the reference section is expanded and better organized for ease of use.

The program does not adequately mark text slated for deletion or movement. The block ought to be highlighted.

InfoWorld Magazine



Makes sense.

A new block highlight feature of WordPerfect 4.0 lets you know exactly what block of text you have defined.

The program would be enhanced if it regularly saved text to disc.

Done.

InfoWorld Magazine

WordPerfect 4.0 allows you to set desired intervals for automatically saving text.

And there's more.

Other WordPerfect 4.0 enhancements include a new template with commands consolidated in the function keypad; enhanced printer management; a network version of 4.0 supporting selected networks; an auto-date insert feature; a cursor definition capability; automatic paragraph numbering; automatic outlining; and redline and overstrike printing.

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Manning the Fort At Los Alamos

How they learned to stop worrying about budgets and love their PCs.

BY CHARLES BERMANT

LOS ALAMOS, N. Mex.—This once secret city, created exclusively for the development of the atomic bomb, has evolved into a high-tech Shangri-La. Since the 1976 purchase of its first Altair, the Los Alamos National Laboratories have kept abreast of the personal computer evolution, with the latest available products represented in their on-site equipment.

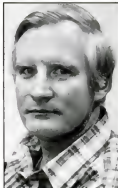
When the market for personal computers began heating up in 1981, LANL management estimated that they would purchase about 50 PCs. However, by the end of that year, the estimate had been exceeded tenfold. Not surprisingly, IBM itself offered the best deal. By November 1984, the number of PCs had climbed to 1,600, and their applications ranged from classified data manipulation and satellite control to cafeteria management.

"I can't think of any PC use that isn't done here—except maybe general ledger, which is still handled by our mainframes," says staff member Lynn Maas. "We have even stretched Lotus's 1-2-3 to plot scientific data."

The reason for the PC's extensive use is that it melds more easily into lab operations than a limited-function tool would. According to associate group leader George Merritt, "the PC has the capability to carry out many different tasks—from that of a data collector to that of an administrative tool."

"We have found uses for the PC that IBM never imagined," says staff member Frank McGirt. "It has resulted in amazing savings of government money."

But PC users on the Los Alamos staff stress one thing: No matter how much they tout the



Frank McGirt

virtues of specific hardware configurations and software packages, it should not be construed as a product endorsement.

New Mexican Standoff

In addition to making lab life more efficient, the PC cuts through the litany of guidelines that govern the everyday decisions of Los Alamos employees. Since parts and peripherals for the PC are cheap enough to be bought from the available budget, the byzantine official procurement process can be sidestepped.

In other areas, however, PCs help make the red tape stick. One of the most common uses of PCs at the labs is for budget planning. Rather than get a massive monthly printout on the mainframe, managers can now do local forecasting based on information relevant to their own departments. This can help foresee and prevent overruns and as one employee says, "If you overspend here, you die."

"With PCs, you have access to the numbers you need," says program manager Gerry

Maestas. "If our utilization of PCs isn't yet 100 percent, it's because it's still new. The lab environment lends itself to extensive use of PCs—they make us more productive at any level."

One PC-related function high on Maestas's list is the Labs's electronic mail system, which allows employees to leave messages for each other instead of "getting stuck in a lot of useless conversation, which even scientists tend to do."

LAN of Enchantment

The use of local area networks in the Labs is snowballing, and users can even (with the proper password, of course) access one of the six Cray mainframes. Of the 1,600 PCs in the Labs, 400 are XT's and 50 are AT's (Los Alamos, like the rest of the country, can't get enough of the new hybrid). Fewer than 100 of the PCs are Tempests, the National Security Council-approved machine that has been configured not to emanate any radio signals.

"We are looking for ways to come up with other configurations that don't emanate," says Maas, "but there isn't a whole lot of classified computing done on PCs. First of all, it's required that classified material be locked in a safe when it's not in use—something that's difficult to do with a hard disk. And each Tempest costs \$7,000, so there are budget limitations."

Fiscal constraints prevent there being a PC on every desk; instead, common terminal areas have been established. Therefore, having an XT or AT of one's own reflects a certain status. "The higher managers end up with the XT's," says Maas, "so they don't have to figure out which floppies to load when."

"We have found that a programmer who has a PC at his desk is more productive," says Merritt. "It's a flexible tool. They end up creating a prototype of a large system on a smaller machine."

Frank McGirt says, "The PC is so flexible, that we have used it to integrate some tools that were never meant for scientific use—and that's really nice."

But McGirt also feels that

this can be carried too far. "People try to change the experiment to fit the machine. PCs are so easy to use that people try to do things they shouldn't. They aren't good for gathering large blocks of scientific data, or anything that requires a multi-second response."

In fact, software is not only diverse, but customized. For instance, the FORMAT program under DOS has been patched so that it will not accidentally wipe out a hard disk. Another staff-written program manages the constantly fluctuating secretarial pool and maintains inventories of people's requirements and abilities in a skills database. These programs can't be marketed, and whatever unclassified software is developed here becomes public domain.

Word processing, oddly enough, is the bane of PC use in the Labs. Says Maas, "A lot of our word processing for heavy scientific applications requires the Greek alphabet and other symbols. There is no good scientific word processor for the PC."

Making copies of programs for home use is, of course, against the rules, and even copying a software package for use within a division is also against the Lab's policy.

Los Alamos personnel have widely fluctuating software needs, and the Santa Fe Computerland receives their requests for programs by the crate. Store manager Al Harding says that "Los Alamos people call up and ask for stuff that no normal human being would order."

Mainframes will always be an integral part of life at Los Alamos, and the room which houses them remains off limits to most personnel. But as McGirt and other scientists coax new functions out of desktop machines, the Labs's PC explosion has demystified computers for the greater part of the Labs's work force.

Clearly, Los Alamos employees aren't typical PC users. For one thing, they seem to have more passionate feelings about their computers. And, as scientists, they are intent on stretching the machine beyond its intended limits. ■

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CIRCLE 536 ON READER SERVICE CARD

Sorting Out Sorting Programs

Helpful hints in deciding which utility is right for you.

BY CHRIS TERRY

NEW YORK—If you regularly use a complete database package such as *dBASE II* or *Lotus's 1-2-3* you're unlikely to need a separate sorting program, since these packages have a built-in sorting feature. However, if you use a word processor to extract, collect and manipulate data, then a sort/merge utility is almost essential.

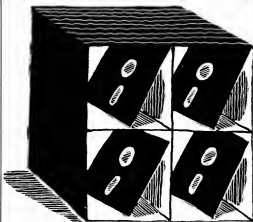
Which utility you should choose depends on how often you will use it, the volume of data to be sorted, and your budget. Figure 1 holds a summary of the main features of four sorting utilities for the IBM PC: the simple, *SORT* command built into PC-DOS; *PCSORT*, a powerful but rather slow package from Microsoft; *COSORT*, a fast, flexible package from Information Resources; and the jet-propelled *Supersort II* from MicroPro International.

The times given in Figure 1 show relative speeds only, and were obtained using a batch program that obtained the time from a Tecmar clock/calendar before and after calling each sorting method. Program loading and time displays contribute 2 or 3 seconds to each of the times shown, but are constant for all the packages. The input consisted of files created by a random-word generator that contained 1,000, 2,000, 4,000, or 10,000 lines of ASCII characters. In the first run, each line consisted of a random-length word padded with trailing blanks to 20-character length. The second run used unpadded random-length words, resulting in a smaller file. In all files, 40 percent of the lines contained an upper-case letter in column 1; all other characters were lower case, with no numerals or punctuation. This test material could be handled by all the sort utilities and was more representative of live data than a sequence of random numbers would have been.

PC-DOS SORT

The *SORT* command is very limited in scope and very, very slow. However, it can be useful with short ASCII files (less than 500 entries) of names and numbers to be put into ascending or

SORT command, and gains an additional advantage on files of 40–60K. *PCSORT* can merge any number of presorted files and handles any type of file, of any length, including those generated by high-level language



descending order. *SORT* can't handle any file larger than 63K or that contains numerics in binary or packed decimal format.

You define the sort key by specifying the column in which the key is to start; *SORT* then treats the rest of the line as the key. It offers no facilities for record selection on the basis of key value. Collation (the character sequence in which the file is ordered) is in standard ASCII sequence (digits, uppercase, lowercase); so *ZYGOTE* would precede *anaconda* in the sorted file. The */R* option sorts the file in descending alphabetic order. I/O redirection and pipes may be used with this command.

PCSORT

Microsoft's *PCSORT* concentrates on flexibility and selection power rather than on speed. On small files it's approximately twice as fast as the PC-DOS

compilers.

The maximum number of sort keys is 255, and sorting can be performed on any combination of keys; keys may be defined by starting position and length in

PCSORT

IBM Entry Systems Division
P.O. Box 1328
Boca Raton, FL 33432
(800) 426-3333
List Price: \$175
Requires: 128K RAM,
one disk drive.

an ASCII file, or by fields containing any of the data types supported by IBM PC BASIC, COBOL, FORTRAN, or Pascal. Input records may be rejected or selected for transfer to the sorted output file on the basis of key content tested or compared by IF-THEN-ELSE statements.

It is common to invoke

PCSORT with a command file as the only argument. The command file (stored on disk) contains statements that specify input and output files, keys, and conditional processing.

The default collating sequence is standard ASCII, but you can change this to EBCDIC or to any other desired sequence by using a translation table. The *XTABLE* program, supplied with the package, allows you to create new tables and to save them on disk.

Two versions of *PCSORT* program are currently available: one is a standalone version to be invoked directly from the DOS command line or with the aid of a command file; the other is designed to be linked to and called up from an IBM COBOL applications program.

COSORT

The *COSORT* sort/merge utility, from Information Resources, is 3 to 10 times faster than *PCSORT* and 5 to 22 times as fast as the PC-DOS *SORT* command—the bigger the file, the greater the speed advantage. *COSORT* is set up as a coroutine that can be invoked from a standalone interactive driver, from a batch command, or from within an applications program. *COSORT* can handle records up to 4,096 characters long; the maximum number of sort keys is 255, and each key may specify ascending or descending order.

The advantage of the coroutine is that the calling program (whether DOS or an applications program) can begin processing sorted data long before the sort has been completed. For example, after specifying that output data should go both to an output file and to the console, a 4,500-line input file was completely sorted in 50 seconds, but the first sorted lines appeared on the screen after only 10 seconds. This data was also in the output file and available for processing by another applications program. This feature often reduces total processing time.

COSORT is provided in two forms: one is linked to the standalone drivers *COUP* (continued on page 52)

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Sorting Programs (continued)

(which accepts commands interactively from the console) or RECOUP (which takes its instructions from a command file stored on disk); while the other is a relocatable object module that can be linked into an ap-

COSORT

Information Resources, Inc.
Box W
Manhasset, NY 11030
(516) 365-7629
List Price: \$150

Requires: 64K RAM,
one disk drive.

plications program written in a language that has facilities for calling assembly-language routines.

COUP's human interface is excellent. Prompts are clear and helpful, and when the sort is completed it gives you the option of saving the parameters in a command file for further use with RECOUP. The documentation is explicit and adequate for both user and program developer; it gives examples of how to link COSORT into an assembly language program and a BASIC program and how to pass parameters and results.

Supersort II

Supersort II, from MicroPro International, is the Cadillac of sort/merge utilities. It has more selection features and can handle more data types than the other packages reviewed here, and it is blindingly fast—6 to 22 times faster than PC-DOS SORT. This is a real advantage when you have large volumes of data. *Supersort II* can be invoked from a DOS command line containing filenames and attributes as arguments; however, to avoid mistakes it is better to invoke *Supersort II* without an argument. The program then prompts you for the required information. Alternatively, you may invoke *Supersort II* with the name of a command file that contains the required information. Unlike *PCSORT*, *COSORT*, and the CP/M-80 version of *Supersort*, the IBM PC version does not come with a linkable object module that can be invoked from within an applications pro-

FEATURE

PC-DOS
SORT PCSORT COSORT Supersort II

TIMES (min:sec):

RUN 1, random words padded to 20 characters.

ENTRIES	FILE SIZE				
1,000	22K	1:57	0:57	0:18	0:25
2,000	43K	6:47	2:06	0:44	0:43
4,000	86K	NA	4:54	1:27	1:18
10,000	215K	NA	12:54	5:05	3:07

RUN 2, random words 1 to 16 characters.

ENTRIES	FILE SIZE				
1,000	11K	1:17	0:43	0:17	0:13
2,000	21K	4:48	2:09	0:27	0:29
4,000	41K	18:48	7:29	1:08	0:51

INVOCATION:

Standalone Driver	NA	Yes	Yes	Yes
Command Files	No	Yes	Yes	Yes
Linkable Module	No	Yes	Yes	No
MERGING:	No	Yes	Yes	Yes

INPUT FILES:

Maximum number	1	NA	127	32
Maximum size	63K	NA	NA	NA
ASCII, CR-delimited	Yes	Yes	Yes	Yes
BASIC & other types	No	Yes	Yes	Yes

KEYS:

Max. number of keys	1	255	256	32
Positional	Yes	Yes	Yes	Yes
Comma-delimited & other	No	Yes	Yes	Yes

SELECTION:

Conditional	No	Yes	Yes	Yes
Reject	No	Yes	No	Yes

COLLATING SEQUENCE:

ASCII	Yes	Yes	Yes	Yes
EBCDIC	No	Yes	No	Yes
Other	No	Yes	No	Yes

SPECIAL OUTPUT FILES:

	No	Yes	No	Yes
--	----	-----	----	-----

Figure 1: A comparison of the main features of four sorting utilities.

gram.

Options allow a variety of output files to be created for both merging and sorting operations. For example, the output file may receive only the keys extracted from the input records, or sorted record numbers, or pointers to the input records. These pointers contain the sector number of the file where the record begins and a byte offset to the start of the record. The advantage of such files is that they are much smaller than files containing recorded complete records, though you need other

utilities to use them effectively. This kind of flexibility helps offset the lack of a module that can be linked to and invoked from

Supersort II

MicroPro International
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200

List Price: \$200

Requires: 64K RAM,
one disk drive.

within an applications program.

Supersort II can select or exclude records on the basis of a

wide range of data tests, including tests for a range of values. The numeric values tested may be in any format supported by Microsoft languages for the IBM PC. The default collating sequence is standard ASCII, but you can easily change it.

You can use also *Supersort II*'s facilities for non-sorting purposes such as converting a file to a different type, changing record length, selecting and re-arranging positional fields within each record, and converting data to a different character set.



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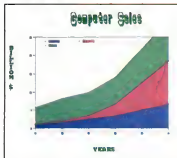
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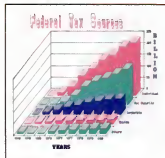
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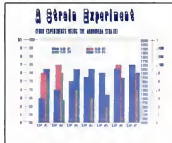
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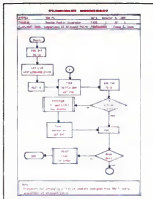
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CIRCLE 134 ON READER SERVICE CARD

PRODUCT REVIEW

Taking to Task a (Multi) Taskmaster

Digital Research's *Concurrent PC-DOS* system opens up your applications options.

BY TOM BADGETT

Concurrent PC-DOS

Digital Research, Incorporated
160 Central Avenue
Pacific Grove, CA 93950
408-649-3896

Requires: 256K RAM, 80-column display, two double-sided disk drives, 512K RAM and hard disk recommended.

Concurrent PC-DOS, from Digital Research, is a brand new multi-user, multitasking operating system that will surprise both PC-DOS and CP/M devotees. It looks like CP/M but works like PC DOS, or vice versa. Like regular CP/M, most system-level programs are named disk files that load and run as needed. But the resident part of *Concurrent* will accept many PC-DOS commands and conventions. *Concurrent* can run up to four PC-DOS or CP/M applications simultaneously and support two users, one on the PC keyboard and one on a "dumb" terminal attached to a serial port.

Power Politics

Although *Concurrent* will run on a dual floppy, 256K RAM system, Digital Research recommends 512K RAM with a hard disk, and even that may not be enough. The software comes on four double-sided floppy disks. The boot disk is in CP/M format, the rest in PC-DOS. A hard disk installation needs at least 1.2 megabytes partitioned for CP/M, and each "window," or application, starts with 64K of RAM. The operating system uses another 150K. If you add it up, you realize that memory becomes a premium in a hurry, even in a 640K system. Unlike some multi-user multitasking packages, *Concurrent* appar-

ently doesn't provide memory partitioning to take advantage of more than the PC's 640K RAM maximum.

Four memory-hungry applications, such as spreadsheets, graphics, or complicated word processors, obviously won't run simultaneously. But a *Concurrent* utility permits adjust-

Practically, however, many of today's popular programs bypass the operating system during screen updates, so if you reduce the size of the window, information may spill over to other parts of the screen.

You can't run more than one application that uses BASICA. And, because most applications aren't designed for a multitasking environment, printer handling and other details of operation may be cumbersome. Of course, these weaknesses owe less to *Concurrent's* deficiencies than to the limitations of today's applications software.

System Interface

Concurrent has a number of system utilities. You can use one to create a RAMdisk, although you probably won't have enough

es. A status line at the bottom of the screen reminds you of printer activity, which drives are active, and what programs are running in each window.

A context-sensitive help utility is accessible from *Concurrent* menus. This is a DOS without the intimidating blank screen common to older operating systems, but you can bypass the menus and help screens if you're comfortable controlling it directly.

Concurrent supports MS-DOS paths with floating drives, which are logical drives for files in DOS root directories or sub-directories. A System disk specification forces *Concurrent* to look for files on the system drive.

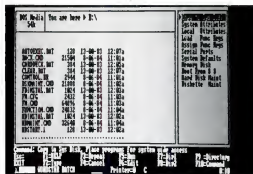
Concurrent's Subset of Files is another method of handling the potentially large directories of a hard disk system. This utility masks all but the specified files from the File Manager, so you see only the subset of files you want to use.

A Nice Idea

The idea of running four applications simultaneously is attractive. The thought of adding a second user to a PC for the price of a serial card and a dumb terminal is exciting. Their implementation on *Concurrent PC-DOS*, however, is a little disappointing. With four programs operating, the PC slows down noticeably. (It does run better on the PC AT.) The serial user can't run most of today's popular programs.

For a program such as *Concurrent* to be really useful, the applications have to be designed around the operating system. Moreover, multitasking systems may be the coming trend, but who will set the standard? *Concurrent* must compete against IBM's *Topview*, which many industry observers are betting on to become the multitasking standard for the PC.

Concurrent PC-DOS works, the documentation is clear (though the preliminary version didn't have an index), and it's easy to use, considering its size and power. But the sad fact is, today's most popular processors and software simply aren't ready for it yet.



This Concurrent PC-DOS display shows a command menu and special functions:

ment of the memory allocated to each window. *dBASE II*, for example, should run in only 48K, but 1-2-3 will need 150K or more, depending on spreadsheet size.

The serial terminal can't run programs that use direct screen addressing because the PC's video handling won't work with an RS-232 remote terminal. A measure of file security is provided for CP/M files, but there's no true file-locking protocol to prevent the serial terminal user from overwriting files of the main user.

The software starts with a full screen assigned to each window, but the size and position of the four windows can be adjusted, so you could theoretically have four applications running on the same screen.

memory for four users and a RAMdisk. Each window can have up to 50 custom function keys, and separate STARTUP files—like the MS-DOS AUTOEXEC.BAT file—help customize each window. Also, editing the DOS command line is easier and more versatile than with MS-DOS. Application programs for data communication, word processing, and Rolodex-type name and address files are included, but you may want more comprehensive programs for some of these tasks.

A File Manager (FM) program provides easy interface between the user and the operating system. With FM you can select most of *Concurrent's* features from a series of menus. The program uses window addressing with window-like box-

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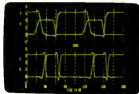
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MICROCAP: Your Analog Solution

MICROCAP is an interactive analog circuit drawing and simulation system. It allows you to sketch a circuit diagram right on the CRT screen, then run an AC, DC, or Transient analysis. While providing you with libraries for defined models of bipolar and MOS devices, Opamps, transformers, diodes, and much more, MICROCAP also includes features not even found in SPICE.

MICROCAP II lets you be even more productive. As an advanced version, it employs sparse matrix techniques for faster simulation speed and larger net-

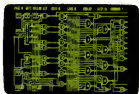


"Typical MICROCAP Transient Analysis"

works. In addition, you get even more advanced device models, worst case capabilities, temperature stepping, Fourier analysis, and macro capability.

MICROLOGIC: Your Digital Solution

MICROLOGIC provides you with a similar interactive drawing and analysis environment for digital work. Using standard PC hardware, you can create logic diagrams of up to 9 pages with each containing up to 200 gates. The system automatically creates the netlist required for a timing simulation and will handle networks of up to 1800 gates. It provides you with libraries for 36 user-defined basic gate types, 36 data channels of 256 bits each, 10 user defined clock waveforms, and up to 50 macros in each network. MICROLOGIC produces high-resolution timing diagrams showing selected waveforms and associated delays, glitches, and spikes—just like the real thing.



"Typical MICROLOGIC Diagram"

Reviewers Love These Solutions

Regarding MICROCAP... "A highly recommended analog design program" (PC Tech Journal 3/84). "A valuable tool for circuit designers" (Personal Software Magazine 11/83).

Regarding MICROLOGIC... "An efficient design system that does what it is supposed to do at a reasonable price" (Byte 4/84).

MICROCAP and MICROLOGIC are available for the Apple II (64k), IBM PC (128k), and HP-150 computers and priced at \$475 and \$450 respectively. Demo versions are available for \$75.

MICROCAP II is available for the Macintosh, IBM PC (256k), and HP-150 systems and is priced at \$895. Demo versions are available for \$100.

Demo prices are credited to the purchase price of the actual system.

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BOOK REVIEW

One Step Beyond

Using Symphony and Mastering Symphony
pick up where the Lotus manuals leave off.

RICHARD WERBIN

Mastering Symphony
Douglas Cobb
SYBEX, Inc.
2344 Sixth St.
Berkeley, CA 94710
(415) 848-8233
Copyright: 1984
Cover Price: \$24.95
ISBN: 0-89588-244-2

Using Symphony
Geoffrey LeBlond
and David Ewing
Que Corporation
7999 Knue Rd., #202
Indianapolis, IN 46250
(800) 428-5331
(317) 842-7162
Copyright: 1984
Cover Price: \$19.95
ISBN: 0-88022-124-0

In 1983, Douglas Cobb and Geoffrey LeBlond wrote a very good book called *Using 1-2-3* (Que Corporation). In fact, they managed to accomplish the rarest of all tasks for a technical book: *Using 1-2-3* was clear enough to be helpful to novice 1-2-3 users while still providing valuable information, ideas, and techniques to knowledgeable and experienced users. Now, Cobb and LeBlond have gone their separate ways, and each has written a book to help you learn about *Symphony*. LeBlond has teamed up with David Ewing to write *Using Symphony*, while Douglas Cobb has written *Mastering Symphony*.

Supplementing Lotus

Mastering Symphony and *Using Symphony* are aimed at an audience ranging from first-time *Symphony* users to experienced 1-2-3 users to pros who have varying levels of experience with some of *Symphony's* features. Both books supplement the Lotus manuals, the in-

occasional complaints about *Symphony's* design features. In fact, the book tells you some very useful things that were left out of the Lotus manuals.

When Cobb describes *Symphony's* word processing features, he includes a technique for formatting part of your text in bold print that is much simpler than the "official" seven



teractive computer tutorial, and the on-line help facility. However, each book emphasizes different *Symphony* features.

Mastering Symphony is both a reference book and a tutorial. All the standard *Symphony* topics—spreadsheets, word processing, data management, graphics, and communications—are explained in detail. Separate chapters cover the use of windows, macros and the *Symphony* command language, the add-in program feature, and an introduction to data communications.

Mastering Symphony's real strengths are the tips, tricks, warnings, clarifications, and



keystroke technique given in the *Symphony* manual. *Mastering Symphony* tells you how to do the same thing in only three keystrokes. This helps obviate the common complaint that *Symphony* requires more keystrokes to perform some of its tasks than other programs do.

Cobb warns you about the DOS APP add-in program. This feature allows you to exit from *Symphony*, run a program such as *FORMAT*, and return back to the point from which you exited. *Mastering Symphony* warns you to save your file before you try the program. I can personally attest to the wisdom of this warning.

Using Symphony attempts to start where the Lotus manuals leave off. Ewing and LeBlond try to explain all the basic features of *Symphony* and to clarify the fine points of usage by systematically covering all the major *Symphony* topics. In addition, *Using Symphony* includes a chapter on a comprehensive model that ties together all the *Symphony* environments. The chapter on macros details the practices to follow in building up and testing a personal macro library.

Clarifying the Fine Points

If you have a lot of experience with 1-2-3, then you will appreciate the fact that this book puts a label, "New with *Symphony*," in the margin when it discusses a feature that was in 1-2-3 but was changed or expanded in *Symphony*. It also includes a 1-2-3/*Symphony* cross-reference guide that compares 1-2-3 menu commands with their corresponding *Symphony* menus. *Using Symphony's* screen shots are noticeably better than those of *Mastering Symphony*.

Accurate Titles

Using Symphony and *Mastering Symphony* both provide important supplements to the Lotus manuals. They offer clear explanations, valuable hints, and numerous examples. Curiously, the titles of these books are quite accurate and certainly appropriate. *Using Symphony* is devoted to the use and understanding of *Symphony*. *Mastering Symphony* goes beyond this plateau to help you conquer various techniques and gain insights into tips and tricks of the system.

On some topics, *Using Symphony* is clearer and more systematic in its approach. On other topics, *Mastering Symphony* offers more depth and better ways to get things done. If I had to choose just one of these books for myself, I would buy *Mastering Symphony*. However, if you plan to use *Symphony* extensively, you might want to purchase both books so you can benefit from two different insights into this complex but extremely useful program. ■

Breakthrough Beats the Clock

From a software company eager to put itself on its corporate back, we received a press release with this headline: "Breakthrough Software Combats 'Vaporware' by Shipping *Time Line* On Schedule, September 29, 1984." (For details on *Time Line* see *PC*, Volume 3 Number 22, page 62.)

Breakthrough's president, William Lohse, claims "one of the reasons that we were able to get the product out on time was that we had such a great tool (*Time Line*) to schedule all aspects of developing, producing, and marketing *Time Line*."

We congratulate Breakthrough on meeting its September 29 deadline, but perhaps Lohse should give an extra copy of this time-budgeting program to his publicity department. The announcement was labeled, "For immediate release October 22, 1984."

—James Langdell

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PRODUCT REVIEW

Covering Your Financial Assets

Scarborough's personal finance program helps manage your money matters.

BY RICHARD POWELL

Your Personal Net Worth

Scarborough Systems
25 N. Broadway
Tarrytown, NY 10591
(914) 332-4545
List Price: \$99.95
Requires: 128K RAM, one disk drive (two recommended).

Your business may run smoothly, but getting a handle on your personal finances can often be a little too time-consuming to keep up with. This familiar scenario inspired Scarborough System's *Your Personal Net Worth*, which may just be a way to retake control of your own financial resources. The program was written exclusively for individuals and not for small businesses, and even computer novices will have no problem using it effectively.

Before you are able to effec-

tively use a financial software program, you must develop a basic understanding of financial organization, logic, and terminology. If all this intimidates you, never fear. *Your Personal Net Worth's* instruction manual will soothe your anxieties, hold your hand, and walk you through the maze of money and its discontents. Armed with this knowledge, you can now do battle with your finances.

Your Personal Net Worth can handle 350 different financial categories, record over 4,000 financial records on each disk, and manage ten separate bank accounts. Your financial condition can be reviewed by displaying data (in color) and printing reports. Financial records can be displayed and printed in graphs. It can reconcile your bank accounts each

month and print checks if you wish. And your tax-deductible items can be filed throughout the year so that you will be ready for April 15.

As you operate the program, additional on-screen help is always available simply by pressing a key. This reduces the need to constantly check the manual and speeds your work pace.

However, an increase in speed often results in a decrease in accuracy. Mistakes, no matter how insignificant they seem, can not be permitted in a financial program. So, once again, *Your Personal Net Worth* provides help. Realizing that mistakes are bound to happen, it allows you to easily correct them while making entries, after entering, before posting, and after posting. Before entering data, you are always asked, "Are you sure?" This allows you to double-check your figures on the screen. If you have already made a mistake, you can fix it easily and the program will automatically adjust all affected accounts.

Most of your activity will probably take place within the Money Management sector. This part of *Your Personal Net Worth* sets up fixed account categories (income, expense, asset, liability, and credit card). These categories contain sub-categories that you can change

to suit your specific needs. Budgets for income and expenses can be set up and printed or displayed. You can create reports to show income statements, net worth statements, and transaction histories.

The Tax Record sector keeps track of tax-deductible items as well as tax paid on entries. The Personal Property sector keeps an inventory of your personal belongings, an often neglected part of your financial picture when you go to a bank for a loan. The Stock Portfolio sector records your stock purchases and sales and keeps a history of your portfolio.

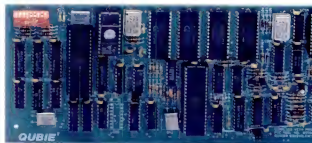
The Dollar Analyzer sector analyzes borrowing options, creates an Amortization Schedule, projects savings goals, and estimates the effects of inflation and deflation on long-term investments. The Maintenance and Year-End sector performs data-maintenance functions, closes your financial records for the year, and prepares for the next year's financial records.

Scarborough Systems has targeted *Your Personal Net Worth* at homeowners who need assistance managing their money. It has scored a bull's-eye by providing them with a helpful, flexible, easy-to-understand financial program that makes money management simple and fast. ■

Calendar of Events

DATE	EVENT	COMMENT	LOCATION	CONTACT
February 4-6	Advanced Features of the C Language	Intensive seminar for C programmers.	Holiday Inn-Crowne Plaza Rockville, MD	Institute for Advanced Technology 6003 Executive Blvd. Rockville, MD 20852 (800) 638-6590 (301) 468-8576 (in MD)
February 16-20	The International Software Update II	Discussions of international and domestic software standards, marketing strategies, and more.	The Waiohale Resort Kauai, HI	The International Microcomputer Industries Association 21 Tamar Vista Blvd. #175 Corte Madera, CA 94925 (800) 732-2300 (415) 924-1194 (in CA)
February 20-25	INFO/CENTRAL	Sessions on telecommunications planning and software for data security.	O'Hare Exposition Center Chicago, IL	Banner & Greif, Ltd. 110 E. 42 St. New York, NY 10017 (212) 687-7730

Inside Outside



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212A/1200E \$329

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Our modems are fully compatible with all Hayes software commands. Software packages like Crosstalk™, Sidekick™ and SmartcomII™ will work with our modems.

Our internal modem card, PC212A/1200, is designed specifically for the IBM PC, PC/XT or other PC-compatible units.* The board occupies only one slot, since it is just 6/10" in thickness. The optional asynchronous port, available for \$40, can be used for other peripherals when the modem is not being used. The modem comes complete with PC-TALK III™, modular phone cable, card edge guide, and user's guide.

Our external standalone modem, 212A/1200E, can be used with any computer or terminal that has an RS-232C serial port. The modem is housed in an attractive gold anodized case and fits comfortably under a standard telephone.

An easily accessible volume control knob adjusts the modem speaker's output. The modem comes complete with modular phone cable, serial connector cable, and user's guide.

Both modems are Bell 103/212A compatible. Both feature auto-dial and can be accessed remotely through an auto-answer mode.

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People in the News: Nelson Winkless

A long-time PC observer ponders life after nuclear war and robotic implants for pups.

BY CHARLES BERMANT

ALBUQUERQUE, N. Mex.—“You have to go a long way to find someone who has less respect for computers than he does,” says a colleague of Nelson Winkless.

Winkless, 50, has been involved with PCs since the industry's inauspicious Albuquerque beginnings. He claims he coined the term “personal computer” in a 1976 local newspaper article, but he won't take all the credit, calling it one of those flashes that hit many people simultaneously. In this case, the paper needed a headline, and “Personal Computer” was the obvious choice.

Most recently, as a cofounder and guiding light of Excalibur Technologies, Winkless was a force in the development of *Savvy-PC*, a database manager with artificial intelligence elements.

“There's nothing you can say that conveys any sense of what the heck *Savvy* is,” says Winkless. “You have to see it first hand. Perceptions are based upon experience.”

A Savvy Campaign

Last May, Excalibur changed its sales strategy, beginning a more aggressive campaign. Since then, it has been shipping 500 units every month. According to Winkless, *Savvy* now has “a life of its own.”

Now, he is marketing Excalibur's new *Retriever*, a software enhancement that allows users to query databases without knowing computerese.

At first, Winkless seems disconcertingly normal: he looks the part of the generic human being. But while demonstrating *Retriever* he becomes more animated—his eyes roll, his hands wave, and his enthusiasm gives one the urge to push him away from the keyboard and give the program a try.

Through it all, he has been



Winkless's computer irreverence that has given *Savvy* its identity. “If Nels can use a program,” says a colleague, “anyone can.”

Calling Winkless's view of computer's merely “unorthodox” is a severe understatement. PCs will, he believes, help us survive the apocalypse. He favors implanting small animals with smaller robots. And by talking to a program he can, seemingly, make it work.

He's amused by the “long-time observer” label often bestowed on him, since the personal computer industry itself is only 8 years old. Still, he displays premier issues of *Personal Computing*, *PC*, and *PC World* as if they were artifacts. Others have compared him to the “punk” on the 4th of July: Everyone sees the fireworks, but nobody notices the guy lighting all the fuses.

Old Friends

“I know most of the major players,” says Winkless. “The first time I went to lunch with (Microsoft founder) Bill Gates, he ordered a Shirley Temple and drank it down before my awestruck eyes. He wasn't old enough to order a beer, not even in New Mexico.”

In that early newspaper article in which he coined the term “personal computer,” Winkless went on to predict that the microcomputer industry would

“succeed, then settle down as part of a new, self-satisfied establishment.” That public prediction landed Winkless himself a leading role in the nascent industry, for it led the publishers of *Personal Computing* magazine to choose him as its first editor.

Noting that some of those involved in the business since its early days have their share of personal problems, Winkless adds that he has been able to sidestep that syndrome. “I've avoided that myself,” he says, “by staying fat, cheerful, and elderly.”

In the artificial intelligence field, in which Winkless has been involved since 1960, the “longtime observer” label sticks. “With artificial intelligence, the machines start to anticipate your needs,” he says. “And a machine that tries to help you is better than one that tries to improve your character.”

Predictably, he is also obsessed with robots; he helped assemble the first personal robot show in Albuquerque last spring.

Robot Convention

“The first personal computer shows were all ‘Ma and Pa Kettle go into the computer hussiness.’ They all had hand lettered signs and craziness,” he recalls. “But the robot show didn't feel or smell the same. The robot industry just doesn't have an establishment against which to work. PCs took the computer industry by surprise. But the robot people don't have anything to be different from.”

Winkless has written two books about robots; the second, *If I Had A Robot*, is about to be released by Dillehoff Press. He says that much of the new book will be perceived as “adequately offensive.” Judging by one of his ideas, animal lovers are likely to be more than adequately

offended.

“You could put a small robot in a dog,” he says. “You'd have power and mobility. Or in a horse. There's a lot of room in a horse. If you had something like that in a dog from the time he was a pup, he wouldn't find it so unusual to back into the printer on a daily basis to output data.”

Is he putting us on? It's not clear. But he concedes that one of his favorite lecture techniques is to weaken his audiences with laughter, and then slip in his point.

Armageddon Out of Here

His own view of the future includes more doom and gloom than one might expect from the average fat, cheerful, and elderly computer nerd. He believes a constitutional convention is imminent, causing the United States government to do a warm reboot. And, if the country's major cities are wiped out by a nuclear attack, Winkless believes personal computers will aid those who survive the fallout.

“In times of stress, you need flexibility, along with the ability to adapt and gather information,” he says. “That's the nice thing about PCs. They'll allow us to be adaptable and flexible, and no one will need to wait for permission to do something.”

The only problem, then, is keeping the electricity running. And he follows his point with a common Winkless technique, asking a pertinent question, then supplying the answer on the downbeat.

“Will personal computers help us after an atomic attack? Yes.”

“Will we be better off at that time because of computer magazines? Yes.”

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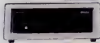
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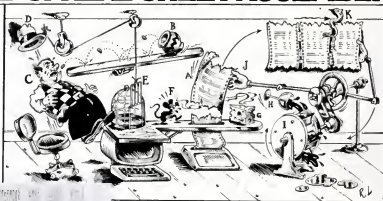
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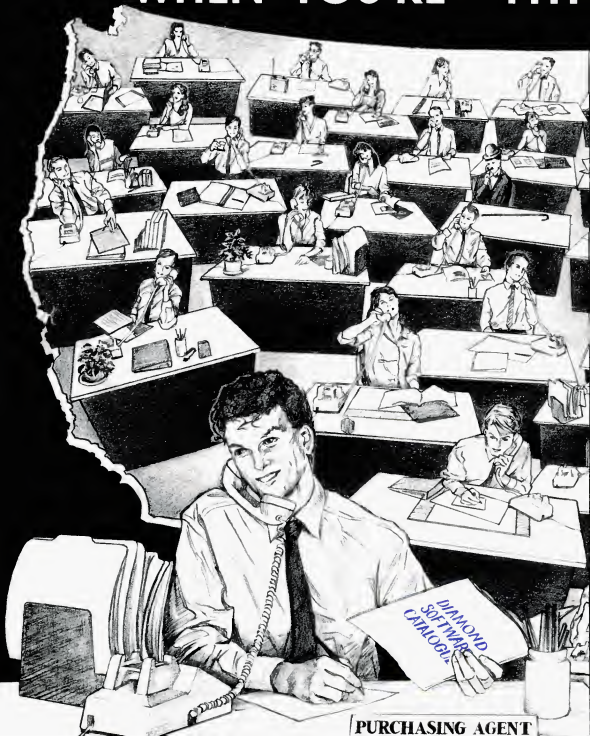
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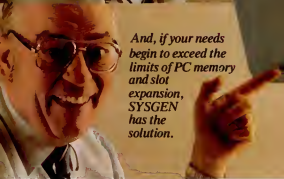
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Network or multi-user: Which is better for your application? Is there an answer? Is there a choice? The debate rages, the products and ideas pour out, and, no, the dust hasn't settled.

Networking continues to be one of the most hotly debated topics in our segment of the market. It's easy to see why: There's more fresh technology, more interesting ideas, more weaving together of hardware and software than anywhere else.

There's also more disappointment, more wasted money, and more recrimination than in any other segment. The problem is due partly to the natural limitations of local area networks. You can stretch a single-user operating system to make it do multi-user tricks in just so many ways.

The other part of the problem is expectation. People expect magic from networks, and they're disappointed when they don't get it. They hate it when it slows down. They curse it when it hangs up. They turn murderous when another user trashes their files. And, of course, they take it for granted when everything works right.

What do you want a network to do? Multiple simultaneous access to database? Electronic mail? File sharing? Sure, why not? But is it the best solution?

Personal computers are now locked in battle with minicomputers. You are the battleground. Minicomputers were designed from day one to do all the things listed above, without creating conflict among users. They stole a march from

mainframes in supplying low-cost computing to the end user. Personal computers did the minis one better by putting the whole machine on the desk top.

More than user liberation, program-



Bill Machrone

mer liberation set the stage for the microcomputer revolution. The freedom of fast, exclusive access to screen, memory, and disk touched off a software revolution that continues. We're all beneficiaries, but we always want more. Networking is just part of the "more."

The funny thing is, we haven't gained much. Any minicomputer worth its salt is more than a match for a PC in terms of computing power and fast access to disk files. Plus, its operating system and its compilers assume multiple simultaneous

access to files and tight security as givens. But, you may say, the screens are so slow. Who can live with them?

Most minis run their terminals at 9600 baud, or about 1,000 characters per second. Worst case, it takes up to 2 seconds to replace every character on the screen, and most updates take a half-second or less. That still isn't as fast as the PC's near-instantaneous "flash," but there's another side to this argument.

Let's say you've decided to network your PCs to give everyone access to a server with a large hard disk. Each user has a network boot diskette and a collection of private data diskettes. There's no need for the usual program disks, because they're all out on the network. Now, how long does it take to load your application over the network? Six seconds? Ten?

Chances are a mini could have loaded an equivalent application in less time. In fact, on the more sophisticated machines, all programs are re-entrant.

That way, only one copy of a given application is running, no matter how many people are using it. Each user has a private data area, and the operating system lets everyone take turns at the code. The efficiencies are appreciable.

But, you say, I spend most of my time at the keyboard, interacting with the program, not loading applications. Great.

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EDITOR'S SCREEN

But in all fairness, who spends more time waiting, you or your PC?

The real problem with minis is the software deficit compared to PCs. But

that's changing, too, now that micros have shown the way. Not that quality programs weren't available for micros before the micro revolution; they

were—but they were for the gurus, not in the hands of end users.

I'm not trying to convince you to use a minicomputer instead of your PC. I'm not even trying to tell you that minicomputers are better than local area networks. I don't have to, because IBM and the other vendors are doing it for me.

IBM has laid the groundwork for PCs to share the resources of the System 36, a wonderful minicomputer that's making inroads in office automation. Hewlett-Packard uses the HP Interface Bus to do limited networking between their micros and minis. We've awaited AT&T's announcement of a UNIX bridge or a tight Ethernet link to the 3B series for some time now.

Waiting for Minis

We're standing by, waiting and hoping for the real beginning of distributed processing, whereby the operating system "knows about" data and programs and users all over the network. It assigns processors to processes without apparent regard to the location of the user, the data, or the processor. And it does it fast, with a high level of security.

Bold Statement 1: Local area networks cannot fulfill their destiny until they incorporate distributed processing. **Bold Statement 2:** Desktop microcomputers, even the vaunted PC AT, don't have enough horsepower to do distributed processing. **Bold Statement 3:** Minicomputers are not going away. They're back, bigger and better than ever.

Forget all that claptrap about minis being caught in the pincers between micros and mainframes. That was last month's news. Minis are about to enjoy a renaissance. You may not recognize them at first. Some will be packaged as high-end micros with 32-bit microprocessors. Others will look like run-of-the-mill network file servers. Still others will be new, with greatly enhanced abilities.

So you don't have to choose between micros and minis. All you have to do is sit back and wait.

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Letters to PC

Review Teams

After *PC*'s negative review of our *Demi-Plan* project management system, you may have expected a reply from us ("Demi-Plan: Economy Exacts A Price," *PC*, Volume 3 Number 21). I have written this letter not so much to defend our product but to criticize the review process that *PC* used in general.

You went through the trouble of developing a hypothetical project to be used by all your reviewers in evaluating each product. This would have been a good

idea except that the benefits of a common set of data were negated by the use of independent reviewers, each using his or her own writing style and format. The articles devoted to each product did not use common evaluation criteria, nor did each use the same input data. To be specific, it would have made more sense to use common data to yield comparisons of input times, computation times, program accuracy, and chart printing times. I also would have expected to see sample printouts for each product so I could have compared corresponding areas of the reports.

It is also our feeling that the review team should be made up of at least one skilled writer, one person familiar with software applications, and one or more software technicians. This approach would result in a fair and informative review service to your readers.

John J. De Mita

Demi-Software
Ridgefield, Connecticut

Barbara Krasnoff replies:

While we appreciate Mr. De Mita's comments, we must point out that each reviewer in our project management series was sent software to review, a questionnaire, the data to be input, and a script detailing exactly what process was to be followed. All reviewers received and used the same information.

We have considered using review teams and have decided that, while they may produce more standardized reviews, they would not reflect real-world conditions. After all, our readers are not going to have one or more software technicians hanging over their shoulders when they open your software package, are they?

A Truly Independent Guide

I confess that I subscribe to *PC Magazine* primarily for the advertisements. The design, color, and well-chosen words of the more progressive ads never cease to dazzle me.

However, I also have an expectation and strong desire for critical product reviews. This desire rarely becomes fulfilled in today's publishing world. Your issue devoted to printer reviews is a notable exception that goes beyond my wildest expectation for reviews of printers (*PC*, Volume 3 Number 23).

Most reviews settle for pages of charts listing the characteristics of a particular

piece of hardware or software. These charts are almost useless because they give no information concerning how well or poorly these product features work.

Typically, the most that one can hope for with in-depth reviews is that one or two products will be thoroughly tested. This is better than nothing but still leaves out the need to look at these products in relation to others on the market.

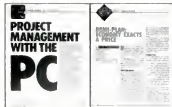
Your printer review issue lives up to the promise of an independent guide to *PC* products. It provides thorough, real-life information that would not be available otherwise. It provides just the kind of in-depth comparison that one ought to do, but is seldom able to do, in choosing a printer. These type of reviews make your magazine an essential tool for *PC* living, rather than just a convenient collection of state-of-the-art advertising.

Tom Marks, Ph.D.
Gladwin, Michigan

Defending Blackjack

I believe that Charles Bermant's review of my program *Blackjack* is a disservice to your readers ("A Look into IBM's Box of Homegrown Software," *PC*, Volume 3 Number 21, page 39). Rather than describing the function of the program, he gives only his impressions of the sound effects and presentation services including screen design and color choices. Nowhere does he describe the game content. I can only conclude that his knowledge of blackjack is like his reporting—superficial.

His last sentence was, "Still, my advice is to play this game alone and with a monochrome monitor." At best, this advice is highly misleading. At worst, it is totally inaccurate. The program design requires the color/graphics adapter card. If you use a monochrome monitor, it must be attached to the color/graphics



idea except that the benefits of a common set of data were negated by the use of independent reviewers, each using his or her own writing style and format. The articles devoted to each product did not use common evaluation criteria, nor did each use the same input data. To be specific, it would have made more sense to use common data to yield comparisons of input times, computation times, program accuracy, and chart printing times. I also would have expected to see sample printouts for each product so I could have compared corresponding areas of the reports.

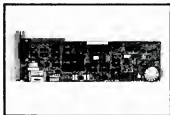
We feel that a better way to review software is through the use of three- or four-member review teams as opposed to the independent writer/reviewer approach you are using. This method is used by product-evaluation periodicals, such as *Consumer Reports*, and is less likely to result in mismatched and unfair

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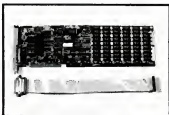
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card (this does not include the standard IBM monochrome monitor). If I had purchased *Blackjack* based on his monochrome recommendation and then discovered that the program wouldn't run on my standard IBM monochrome monitor, I would be very upset.

Blackjack was designed to accurately simulate all of the popular blackjack games played in the major casino areas of the United States. It includes basic strategy screens, based on the game selected, that show the recommended play if you don't count cards. In addition, card counts may optionally be displayed. The game is suitable for serious as well as casual play.

The colors are bright with strong contrast, which allows the screen to be seen from several feet away. Thus, a single operator at the PC can manage the keyboard for up to six players. This option is very conducive to casual, party play. The brightness control is effective for controlling the intensity. As far as I know, no one has become nauseated or hallucinated because of too much *Blackjack*.

Wayne Hammond
St. Louis, Missouri

Charles Berman replies:

Hammond should note that the color display requirement was listed at the top of the review. I tested the game on the PC AT and the AT&T computers. The latter, like many compatibles, includes a graphics board that drives a monochrome monitor. On this basis I recommended using a monochrome monitor.

XyWrite II-Plus Gripes

After reading PC's ebullient praises of *XyWrite II-Plus*, I purchased the program for myself ("The Word on Word Processors," PC, Volume 3 Number 17). Now I'm not so sure I bought the best program.

The reviewer states, "You have at your fingertips all of the functions that you would normally expect, plus features you would not have thought

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of. . . " But with *XyWrite II-Plus*, you don't have proportional spacing, on-screen underlining, italics, context-sensitive help screens, or any method of changing pitch except for modifying the printer table. You also don't have an on-screen representation of what you're going to print until you go through a review process, and then the screen still doesn't reflect justification or the correct number of lines at the bottom of each page.

The program has some significant glitches. I know you are already aware of some of the shortcomings of *XyWrite II* since you reported the difficulties that ensued after PC's staff changed its word processor to *XyWrite* (What's Inside, PC, Volume 3 Number 21). Text goes blank when you underline it unless you use a color monitor. If you use superscript, you see a blinking section of text. If you want to change this, you have to follow the manual's disjointed, sparse directions on revising the printer driver. Also, the program occasionally locks up, and you have to shut off your computer, reboot, and lose a lot of unsaved work. The pause feature does not work with my NEC printer. Another problem is that you can't edit headers; you must erase them and reinput them.

Perhaps your reviewer meant that *XyWriter II-Plus* has all the editing features you would expect, but the program is really lacking in printing features.

My experiences with *XyQuest* have not been positive, either. The company has no toll-free number that I know of, and it doesn't even bother to respond to phone calls, letters, or customer complaints. And it doesn't seem to notify registered users of improvements.

Richard R. Milewski
Garden Grove, California

Maybe your copy of XyWrite is misinstalled, or your're expecting it to be Microsoft's Word. The installation process probably folded in the wrong screen attributes, or your're using a composite mono monitor off a color card. Ma-

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Corrections:

The correct phone number for Mich Rothman's bulletin board, RBBS of i cific Palisades, is (213) 459-64 ("West Coast Communications," F Volume 3 Number 24, page 97).

Premd, the database found in the B medical Bibliographic Library, i database of recent literature from 1 journals, not information for college s dents ("A 22-Hour Library Card," F Volume 3 Number 24).

In PC, Volume 3 Number 23, the pict on page 162 is not of a Seikos GP-550, but rather of a Seikosha Mo-BP-5020. The BP-5020 is now be marketed as the Comrex ComRiter 4 (see page 212 for its review).

The last line of the sidebar to "Typographic Power from the PC," (PC, Volume 3 Number 25, page 252) was inadvertently dropped. The paragraph should have ended as follows: ter.—T.S.

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Software for One and All

The cries for software by owners of non-PC-compatible computers should soften even the most stone-hearted. But the reality is that generic software has been wishful thinking.

In past columns I've commented generally on the problems of writing generic software, programs that will run equally well on all sorts of modern desktop computers, even those that aren't PC-compatible. I'm talking, of course, about writing software that can be run on odd machines like the TI Professional, the ACT Apricot, and others.

In the past my remarks have been general and philosophical, concerned with the widespread benefits of universal or portable software. If such software were practical *now*—and you can tell by my syntax that it isn't—everybody involved would gain.

Alas, it isn't so. The reality is that there's no practical way for most software creators to write generic software. Microsoft has a grand plan, with *MS-Windows*, to create a universal environment, similar to that of Apple's Macintosh, which would run generic software. It's a grand and noble scheme, but one that may not succeed. Its release date keeps changing, and so does its chance for widespread acceptance. Current rumors are that Microsoft is retrofitting *MS-Windows* to be compatible with IBM's *TopView*. That's an interesting topic in itself.

The Key to Generic Software

To get down to brass-tack specifics,

since I've just recently rewritten my own software, the *Norton Utilities*, I've had to face the issue of making it run on as many machines as possible. It's one thing for me as a columnist to say how



Peter Norton

everybody else ought to be writing universal software. It's another to see what I actually did when faced with the practical problems involved. My solution to the problem is what I want to tell you about today.

The technical problem centers mostly on the creation of screen display output, the messiest and most computer-dependent part of software creation. How do you place information onto the display screens of a wide variety of computers?

The practical solution I ended up with

was to create three separate "screen drivers," three sets of subroutines that use different techniques for controlling screen output. When my program starts up, one of the three is selected and all output that the program generates is routed to whichever driver is in use.

Three Drivers, Three Stories

The three drivers provide three degrees of machine independence, with corresponding degrees of performance. The fastest and most machine-dependent driver places its output directly into the display screen's memory—a widely used technique in PC software that depends to a great extent on the exact features of the PC's display adapters. This technique is so machine- (or adapter-) specific, in fact, that even IBM has begged folks for years not to use it. But the truth is that most of the best software uses this technique because it's so ruthlessly efficient. This method is used so much, in fact, that IBM modified the design of the PCjr especially to accommodate it, and recently the corporation has gone on record saying it will design all future display adapters to live at peace with this method.

The second of my three drivers creates output just as IBM wanted in the first place—by using the ROM-BIOS services that are built into each PC. (I'll comment more on this driver and com-

pare it to the first one later.)

My third screen-display driver is simultaneously the most generic and the most pathetic in performance. This one

uses a facility that's been an optional part of DOS since the introduction of DOS 2.00—the ANSI device driver. The ANSI driver is a curious piece of soft-

ware that does a lot of strange things. Among its skills are the ability to build screen output in a machine-independent way. By issuing the proper commands to the ANSI driver, a program can create full-screen output in a way that will work on any MS-DOS computer (any one, that is, that has its ANSI driver activated).

Although the use of the ANSI driver seems like a simple solution to the problem of writing universal, generic software, in fact it isn't. There are two reasons: first, the driver's performance is too slow and cumbersome, and second, it really isn't as universal as it's cracked up to be. When I tested it on various brands of computers, I wasn't able to get them to all work alike.

No Coming Together

Anyone who has wrestled with the problems of small (but crucial) differences between two supposedly compatible programs or computers knows what I'm talking about. I know that the problems of creating compatible software are enormous and I don't mean to throw any bricks at the ANSI driver and the folks at Microsoft who created it. But the fact is that when I scratched the surface of the ANSI driver, I found problems.

For one thing, there's one position on the display screen that you can't touch when using it. The ANSI driver lets you move the cursor to any place on the display screen and write a character there, except the one in the lower right-hand corner. When you write a character there, the cursor moves to the next line, which scrolls the whole screen upward. Thus, that one location is off limits.

Then I discovered that on some computers, the ANSI driver creates problems when you try to use the first and last columns of the display screen, which leads to further problems.

The practical result of this is that I discovered that if you want to have your software work on any computer by using the ANSI driver, you need to avoid using the first and last columns of each line.

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That cuts the usable width of the screen down from 80 columns to 78. In many circumstances, of course, this isn't much of a price to pay to achieve near 100-percent compatibility with all the MS-DOS family of computers.

ANSI Option

Anyone who wants to write software that at least attempts to be DOS-generic should seriously consider using the ANSI driver as an option within their programs. With relatively little programming effort, it extends the usefulness of your programs to all those machines out there not compatible with the PC.

Nonetheless, although I think that adding the use of the ANSI driver to your programs is important it's clearly not the main issue. The key issue is how to write programs that will successfully generate display screen output on the computers that really count to us—the PC family. We need a way of working with the display screen for every member of the PC family, present and future. This should also include members of the extended family, such as the Compaq and the nifty Data General One. And why exclude the distant cousins, the nice but only quasi-compatible computers like the TI Professional?

We also need to consider the operating system environments—all the versions of DOS through the current 3.10 and on to the 4.00 series and other environments such as *TopView*.

As it turns out, there is a simple unified approach to writing software with screen output methods that will work in all these situations. In this approach, the users do all the screen output work with the BIOS services (the method resorted to by my second driver, mentioned above). Using the BIOS services works beautifully for all the situations I've mentioned, including *TopView* and even the TI Professional and similar machines. That's because the IBM BIOS services have become the most nearly universal standard for software support.

Even machines like the TI Pro have the means to emulate the IBM BIOS when they can't duplicate the IBM display screen memory.

In next issue's column, we'll take a closer look at the problems involved in using the BIOS services and why using my first driver offers a better way. ■

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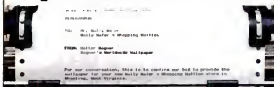
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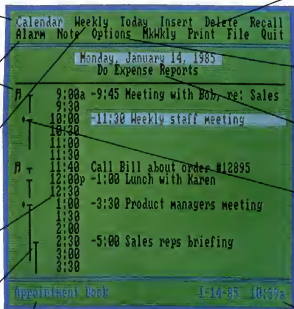
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
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Local Area Networks

The Editors of PC

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Although sharing may bring down costs, it raises issues that standalone PCs, minding only their own business, never had to confront. For example, what configuration for connecting micros gives the speediest data transmission or has the fewest repair problems? How can you be sure that someone else won't write over the database record you wrote or that your co-workers will be able to read it? In the following pages, we'll explain how network components go together and help you answer some of these questions.

PC Magazine also looks closely at 13 local area networks and compares them using carefully devised benchmark tests. Charts that show cost per node and available features will help you make a well-informed network choice.

As if this weren't enough, we present a well-rounded preview of IBM's brand-new PC Network boards and an early look at IBM's network software.

With so much information at your finger tips, you'll be in great shape for getting your net working.

Local area networks are confusing, confounding, fast, and fabulous. They are hard to explain and test. And they are the wave of the PC future.



The Lay Of the LANs

Frank J. Derfler, Jr.

Local area networks are like forest fires and street riots. Just as soon as you think you understand what is happening in one area, something else happens nearby. You aren't quite sure how the events are related, and it's impossible to react to every happening, but you can be sure the fire or the riot—or the network trend—will spread. The topic of local area networks (or LANs) is spreading to include telephone systems and the newest multi-user microcomputers from IBM and AT&T.

Local area networks are for sharing. A local area network is a communications path between one or more computers and different peripherals, and so relatively expensive devices with excess capacity can be shared by several users. This simple

function may be handled in ROM (read-only memory). Systems with more than this basic capability must include network software with various levels of sophistication that controls activity on the network.

You may find installing a local area network beneficial if you frequently need to share data among microcomputers in the same office or geographic area. You may find it economical to buy a LAN if you have a hard disk system that is not filled by one user. (As we shall see later, sharing a hard disk and sharing data are two very different things.) Economy and operational convenience may both play a part in your decision to tie several printers and computers together with a network system.

The decision to investigate using a local

area network is easy to make. The decisions about what kind of network to buy can become very complex.

First Priority

Articles about local area networks are full of technical descriptions and buzzwords. This article is no exception, but before we tackle media and topology, let's discuss the factor you should consider first: software. My best advice is to investigate the features and performance of the network software closely before you even think about other factors such as price or ease of installation.

Think of LAN software as another programming environment you have to work through, just like DOS, BASIC, 1-2-3, *Desq*, or IBM's announced *TopView* software. The LAN software will add its own restrictions to those of DOS and give you more capabilities than you can have by simply changing the printer and serial ports with BASIC statements. You will have to interact with the LAN software just as you do with DOS, and, depending on the design of the software and the functions you want to perform, that interaction can be a prominent burden or transparent pleasure.

The major features to look for in the software available for networks depend on the way you intend to use the network.

Your local area network may reach people with many different levels of sophistication. The software must be simple enough so that people can get a job done even if they have little training or haven't used the system in many weeks. But at the same time, working through the menus must not be tedious for experienced users. Some local area network software packages come with several modules (log-on, resource selection, print spooling, and so on) that must be run in sequence to take advantage of the features of the network. If this modular approach is used, the modules should be selected from the menu by

Now that several users can share disks and data through LANs, many ask what kind of network to buy. The decision can be complex.

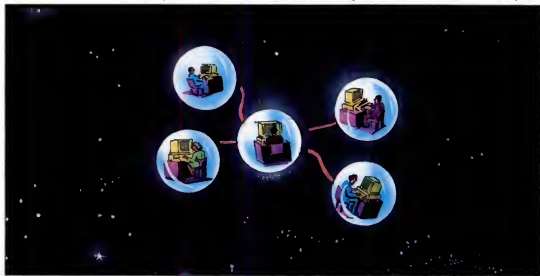


Figure 1: The network maintenance staff can readily troubleshoot any node of a star topology network from its central hub.

function, and related modules (for example, logon and security access level) should be linked so that the person using the program knows both programs have to be run and is shown the proper sequence for their use.

Novell, Corvus, Nestar, and Fox Research have some of the best network software packages available for microcomputers. Novell is making a particularly strong impression on the industry because its software is being used by other companies, such as Quadram, marketing total network systems.

Share and Share Differently

Read the fine print in the description of the disk-drive-sharing software, because there are many different programs with many different capabilities. The local area argot refers to a central system providing one disk every station can use as a "file server."

Other disk-drive-sharing software al-

lows peer stations to share each other's drives. In the most primitive form of this software, every station on the network that shares a portion of a disk drive (hard or floppy) operates only in its own workspace on that disk.

Sharing a single data or program file is not possible. If two or more people want to use a file, it must be copied (by a network software command) into each person's disk workspace. If the file is being updated by one network station, the changes will not be automatically passed to the other stations. Often, advertising for network software of this type says microcomputers using different operating systems (for example, CP/M and Apple DOS) can operate on the same network. This claim is technically true, but it is less frequently true that microcomputers using different operating systems can *interact* on the network. Only a few manufacturers have supplied utilities that are able to bridge the gap between operating systems, and those util-

ities usually operate slowly.

The difference between disk sharing and data sharing is more than semantics. Data sharing involves being able either to have users on different computers access a data file one at a time or to have multiple users access a file simultaneously with adequate protection for all.

The ability to allow multiple users to access a data file is valuable, but only a few companies, such as Fox Research, provide this capability in their networking software. Instead, the most common practice is to write networking software that simply provides the signals to more sophisticated applications programs, which then do the final job of allowing simultaneous file sharing. Thus a few networking programs, such as 10-Net, will allow you to share files using standard versions of MS-DOS programs. Other network software forces you to use specially designed multi-user programs for your database management, accounting, or

NETWORK INTRODUCTION

word processing functions. These applications programs must be available in versions that will work with the networking software you choose. So one decision on software leads to another.

In business networks, not every person using the net should have the ability to write to and/or read every file. The network software should be able to link certain user names and passwords together with system capabilities. In addition, multiple levels of passwords should be required to perform different critical system functions. If you have payroll, accounts payable, or personnel information on any station in your network, security should be important to you.

If networks are for sharing, sharing printers should be a high priority. Simple printer-sharing programs allow one network station to "sign on" to a printer and capture all its attention. If you attempt to sign on to a printer while someone else is using it, you may see a message like "resource busy." You then have a problem of intraoffice coordination. You have to find out who is using the printer you want and determine when that person will be done. This kind of problem can be solved by print-spooling software.

In the best network software packages, print spooling is an integral part of printer sharing, but you have to ask to be sure. Print spooling simply allows you to send your text to the desired printer when you are ready to send it, regardless of the status of the printer at the time. The material to be printed is held somewhere on the network until the printer is ready to go to work for you. You can move your facts, words, and figures out of your workspace and into the print pool, then move on to other jobs.

Communications

Some users of network systems need to communicate with specific kinds of mainframe computer systems. The network

software may include the ability to exchange data with large computers using communications protocols unique to IBM, Honeywell, Burroughs, Sperry, or another manufacturer. Often, LAN purchasers

The ability to allow multiple users to access a data file is valuable, but few companies provide this capability in their networking software.

have large computers using the IBM 3270 communications system. Network software has been announced by IBM (and is available from other companies) that makes the big computer think the network is an IBM 3274 cluster controller working with IBM 3278 terminals. Also, a network may need to accept as a member of the network a station that enters through a dial-in port.

Most local area network systems give the stations that are active on the network the ability to exchange short "chat" messages. These messages often appear on the bottom line of the screen and sound a beep to announce their arrival. Messages of this kind can be used to coordinate operational activities, such as the shared use of a printer. However, chat messages are not stored in the system. They appear on the screen, and then they are gone. More permanent messages are sent through electronic mail.

The software available for electronic mail systems on local area networks ranges from excellent to awful. Mail soft-

ware must recognize the addresses of many users and store messages addressed to them. On-line editing and the abilities to forward, reply to, discard, and send multiple-address messages are all important features of mail systems.

The functions I have listed are almost completely dependent upon the network software. Although a lot of network advertising seems to stress media and protocol, which we will discuss next, the fastest communications media and most exotic network protocol will do you little good if the network software isn't able to give you the services you need. So again, I stress: Look at the software first. After you find the functions you want in one or more networks, look at the other factors that may make a difference to you: media, topology, and capacity.

Media

The word *media* is a local area network buzzword. What it refers to is wiring. Local area network connections use three general categories of wiring: coaxial cable, fiber optics, and twisted-pair cable.

Coaxial cable systems owe a great deal to the popularity of cable television. The quantities of cable and connectors produced for the cable television industry have reduced the prices of these items for local area network use. However, all coaxial cable is not created equal. Certain physical network arrangements benefit from the use of large-diameter cables as main trunks, with smaller cables as local feeders. Some coaxial cable networks require a substantial investment in equipment to translate the radio frequencies used on the cable, but other networks simply tie together the pieces of equipment on the network with chunks of cable. Coaxial cable systems are sold by Quadram, 3Com, IBM, Xerox, and many other manufacturers.

Fiber optic media systems are rare, but they have one practical advantage over

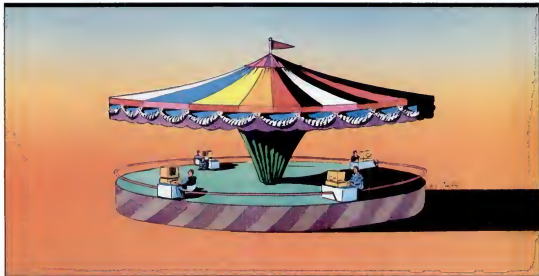


Figure 2: A network laid out in ring topology uses the least cabling. Expansion of the network may require changes at every node.

coaxial systems. They are immune to interference caused by electrical or electronic devices. If you have to run a local area network into an area of heavy industrial activity where welding and motors are present, or if you have to work in an area of strong radio frequency interference, you should consider a network system using fiber optic media. Honeywell is one vendor that has what seems to be a mature fiber optic product. In most cases, fiber optic cable can be substituted for coaxial cable with no change to the network software.

Look at your desk telephone. See the wire going between the phone and the wall? That's one type of twisted-pair wiring that is rapidly gaining acceptance. It may be flat or round, but it usually has four or more conductors inside that can carry computer signals in addition to voices. This type of wire is easy to install and costs little on a per-foot basis. But it has limitations in capacity and speed and is suscep-

tible to interference from electrical and electronic sources. Twisted-pair wiring of this type is used on the recently announced AT&T Information Systems Network and on networks sold by Fox Research and AST Research. One member of the Quadram family of networks also uses twisted-pair media.

Cost and Lesser Media Matters

The primary reason for examining the media that a local area network uses is cost. A good secondary reason is capacity, but this comes into play only if you want to pass a great deal of data quickly or put services such as video on the network.

Fiber optic systems are still the most costly media, because it is difficult to find people who are trained to install and maintain the fiber cables. This situation is changing as more communications carriers install lightwave systems, but costs of \$10 per foot and \$50 per termination in small installations are now average.

Coaxial cable can be physically difficult to install if your building is not designed with large vertical cable ducts and false ceilings or floors. A commonly quoted price for coaxial is \$4 per foot and \$40 per termination.

Twisted-pair cable can cost pennies per foot and only a few dollars per hook-up. You may already have telephone wires in the walls of your building that can be used by a local area network designed for twisted-pair wiring.

The hottest technical issue enlivening the local area network arena used to be the argument over whether to use baseband or broadband media. The issue revolves around the way the coaxial cable connecting the network stations is used electrically. Broadband systems use the cable like a radio link and broadcast a wide number of frequencies over the cable. Network stations can be tuned to specific frequencies to form their own subnetworks just as you tune the channels on your television set.

NETWORK INTRODUCTION

Baseband systems treat the cable like a piece of wire and send strong pulses over it that every station receives. Broadband networks require more electronics and logically should be more expensive to install and maintain. But their cables can be used to pass, in addition to data, television signals, environmental and security system signals, and almost any information you need to move around. Baseband networks are good only for digital data (including digitized voice).

People fought over the issue of broadband versus baseband as if the fate of nations depended on it. The fight seems to have calmed down, but neither side has won. Each has gathered its own devotees and followed its own path. The broadband folks sometimes try to convert people using baseband by offering them special channels on which they can operate just as if they were in a baseband system, but the fight seems to have gone out of both sides.

Unless you want to pass television signals on the same cable you use for your data network, you shouldn't care if it is broadband or baseband. If you don't care, don't even ask.

Topology

Topology refers to the lay of the LAN land: the way information flows on the network. Typical topologies are the bus, ring, and star (see Figures 1, 2, and 3, respectively). A bus system runs along like the branch of a tree; stations hang off the bus like leaves off the branch. Most bus systems use coaxial cable media. Ring systems move information around a ring of stations connected as if they were holding hands. Ring systems use either cable or twisted-pair media. Star systems route everything through a central point, which may be a powerful computer or simply a central wiring splice called a hubbing device.

Bus systems are easy to understand.

Every station hangs off the bus and listens to the traffic as it goes by. If a station wants to put some traffic on the bus, it merges its traffic with the data stream the way you might merge onto an expressway on your way home from work.

But things are less simple when you are dealing with ring and star networks. IBM is the culprit responsible for twisting the simple ring network into something much more complex. IBM wanted to achieve two ideals in network design: short cables and easy troubleshooting. A ring network gives you relatively short cables, but a star network lets network maintenance people test the system from a central point. So IBM twisted the two ideas together and proposed the star-ring topology.

In the IBM topology each node (a node may serve several stations) is attached to a double run of cable coming from something called a wiring concentrator. The double cable runs to each node are connected to form a large ring. The wiring

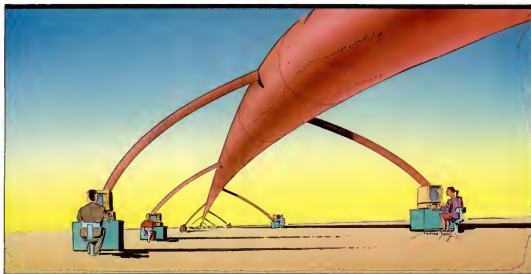


Figure 3: Nodes share a transmission medium in the bus topology. It is easy to add stations; a defective one won't crash the network.

concentrators are connected to form a kind of ring of rings. If a cable is broken, it can easily be patched around so the entire system isn't put out of business for a long time. Since IBM has not released a network using this topology, the concept would seem to be academic. But, because IBM is IBM, its announcement that the company is marketing the cables and parts for this kind of network has induced many companies to jump on the star-ring bandwagon.

Confusion Zone

The other confusion factor in the topology game comes from the introduction of microcomputers with multi-user capabilities. The Tandy model 16, the AT&T 3B20, and many other systems are now available that can serve as hosts to one or more simple terminals or microcomputers acting as terminals. The IBM PC AT is expected to gain multi-user capabilities at about the time you read this article. When a microcomputer is acting as a terminal attached to one of these hosts, uploading and downloading files to and from the host, and using printers and other peripherals attached to the host, I see what looks a lot like a local area network. In effect, technology has taken the concept of the star network and pushed it back into the shared processing idea of the classic mainframe computer.

North Star Computers has confused the issue even more by marketing the Dimension, a centralized multi-user microcomputer using an operating system that can run applications software designed for a decentralized system, the 3Com local area network. So much for easy definitions.

Another strong entry using the star topology is the private branch telephone exchange, or PBX. Modern PBX systems are computers that use various techniques to connect telephone stations. The technique increasingly being used digitizes the voices and establishes what is called a vir-

tual circuit or logical circuit among the instruments. This kind of PBX can easily accept computer data along with voice and move it among workstations. Many PBX vendors are selling telephones equipped with RS-232C jacks.

The advantage of this system is that it uses available cabling and equipment. The disadvantage is that, in its present form, the system provides only the connection. There is little available to do the electronic

The topology of any network that you buy should be invisible to you. You ought to be interested in function, not form.

mail, file transfer, chat, and other functions described earlier. If, however, you can get that software from another source (your office system manufacturer), the PBX can give you an excellent path for connecting the parts of the system. Voice/data PBX systems include ITT's System 3100, NEC's Electra IMS, and the AT&T Dimension. These systems have limited availability, so be careful in making any PBX decision until you check the track record of the company.

The topology of any network you buy should be invisible to you. You should be interested in function, not form. But if you feel it will be important in the future to be wired the way IBM recommends, then perhaps a system that can use the star-ring topology should get extra points in your consideration.

The access protocol used by a network is often the first thing you hear discussed

about a network, and it's probably the least important thing to consider. What do you care if IBM's latest network design uses a token-passing scheme or CSMA/CD, as long as it has software that works for you and can be installed at a price you can afford? Having said that, I will describe access protocols. But don't bother trying to remember what you read. Come back and look it up if there is something you need to know.

Access protocols are the arrangements used to ensure that each station has fair and equal access to the network. They are the rules of the road that dictate who has the right of way and who must yield.

One common access protocol is Carrier Sense Multiple Access, or CSMA. The CSMA arrangement is very similar to a citizens band or police radio system. Stations with data to send listen to the channel and wait until it is clear to transmit. Another feature, Collision Detection (CD), allows a station to listen on the channel as the station begins transmitting. If it interferes with another station, it stops transmitting and waits some statistically determined amount of time before trying again. CSMA/CD is a protocol commonly used in coaxial cable systems, both baseband and broadband. A good example of a CSMA/CD system is Ethernet, marketed by Xerox and supported by many other companies. The IBM/Sytek broadband LAN announced in August also uses a CSMA/CD access scheme.

Network systems with a ring topology lend themselves to orderly access protocols by which each station passes on the opportunity to transmit to its closest neighbor, until a station is found with a message to send. This permission to transmit is called a token. When a station with a message to send is handed a token, the token is changed to show it is carrying a message, and the message to be transmitted is attached to the token. The token is then passed around the ring, and every station

checks the address of the data message. The receiving station copies the message from the token but then again passes the unchanged token along the ring. When the transmitting station gets the token back, it knows the message has been around the ring. The transmitting station erases the message and puts an empty token into the network.

Token passing is a good way to move data in an orderly fashion on a ring or star-ring system. IBM has announced it will use this protocol in its major network products. I will let you decide how well the relatively wild and wooly CSMA/CD scheme of the existing IBM/Sytek LAN will mesh with this orderly scheme. IBM says the two systems will interconnect, but I can't see how it could be a smooth or efficient marriage.

Speed

I have saved speed for last because it is probably the least important factor you should consider. Most microcomputer users are never going to hit the limits of the networks in speed. Disk access speed, CPU speed, screen write speed, and printer response speed will slow things down to the point at which any network will meet the need. IBM rates its PC Net as having a speed of 2 megabits per second. AT&T rates its network at 19.2K bits per second. Yet I wouldn't let the difference in speed influence me in the slightest if I were making a buying decision for a network system of microcomputers.

If you are interested in a local area network system, your first step is to evaluate what you want the network to do for you. This sounds like a simple concept, but it seems to be ignored by many people who love snappy technology or need to "do something!" to improve an operation. If you clearly define your needs and then find the network software to meet those needs, you will have taken a major step in finding the right network system. ■

The Language Of LANs

This glossary of network terms will help you navigate through the nuances of network nomenclature.

access rights: Permission to perform some combination of using, reading from, or writing to a computer file. On a network system, different users may have different access rights.

bus: A network topology in which one channel runs to all nodes on the network, and each node must recognize which messages are addressed to it. Because all stations on a bus use the same channel to transmit, there must be some form of arbitration to determine which station can use the channel when several nodes have messages.

Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA): A protocol requiring that before transmission each station check to make sure no other station on the network is transmitting. If two stations begin transmitting at the same time, the resulting data will be garbled, but the sender will retransmit the data when it fails to get a positive acknowledgment of its message.

Carrier Sense Multiple Access/Collision Detection (CSMA/CD): A method for sending data over local networks that allows many stations to communicate on a single line without any single station acting to regulate the conversation. A station with a message to send first waits until it can detect no carrier, then

starts sending its message. If it detects another message being sent at the same time (a collision), it stops transmitting for a short, randomly determined length of time.

chat: A mode in which two or more users may type messages onto each other's terminals, enabling back-and-forth interactive conversations through the network without waiting for electronic mail to be sent and received.

coaxial cable: A type of communications cable used for networks and for connecting terminals to mainframe computers. Coaxial consists of a central, insulated conductor wrapped with a braid or foil that shares the same axis. This concentric design allows coaxial to carry high-frequency signals, and the foil or braid on the outside protects the signal from outside interferences. Most high-speed networks use coaxial, and a bewildering array of types is now available.

Ethernet: A local data network system developed by Xerox, Intel, and Digital Equipment Corporation. It is one of the more popular protocols used on PC networks. Ethernet is a baseband system that uses coaxial cable.

local area network: A connection among multiple computers intended to allow

the individual stations to share resources and exchange files. By local area network (LAN), most people mean a network used at a single office, building, or group of buildings employing direct connections, rather than a common carrier or private communications system. LANs can be classified by how they encode data for transmission (baseband and broadband), how they regulate the flow of data (carrier sense, with or without collision detection, or token), and their topology (star, ring, or bus).

lock: A software signal that keeps other users from accessing or changing a record or file while it is in use by a first user. Locking can be done at the file or record level; if done at the record level, only the records in current use are protected by locks, while the rest of the file can be changed by other users. Locking can be done by the network itself, by the program, or even by direct command of the user.

node: A connection or switching point in a network. It may be a work station, a dedicated server, or a connection point for routing messages. Most networks are limited in the total number of nodes that can be connected.

Open Systems Interconnection reference model: A model for networks developed by the International Standards Organization (ISO), dividing the network functions into seven connected layers. Each layer builds on the services provided by those under it. By dividing the network into layers, a complete network can be built through the use of different combinations of hardware and software.

protocol: A set of rules for how information is exchanged over a computer net-

work. Protocols can cover the complete network interface or be limited to one or more of the layers out of which the network is constructed. Some of the popular protocols used for PC networks include the Ethernet protocol and the ARCnet protocol.

remote execution: Execution of a program on another computer attached to the network instead of on the one at which the user is located.

ring: A network topology that routes messages through each station on the network in turn. Most ring networks use a token-passing protocol, which allows the station to put a message on the network when it receives a special bit pattern. Many networks that are logical rings actually connect all wires at a central hub, thus physically appearing to be a star.

server: A network station that handles special chores, such as disk storage, printing, or communications. A dedicated server handles only its special chore. In other cases, a PC can be used as a server while still being accessible as a work station.

star: A network topology that brings all links to a central node. It is more often used for switched circuits such as telephone exchanges and PBXs than for local networks. Some networks, though, do use a star shape, running all connections to a central hub. But at the hub, the links are then connected in a bus or ring, so the network logically acts as if it had that topography, with the star shape merely affecting the ease of running the cables.

throughput: The amount of data transmitted through the system per time unit, usually expressed in some multiple of bits per second. Because of overhead

and bottlenecks, effective throughput may be quite different from the claimed rate.

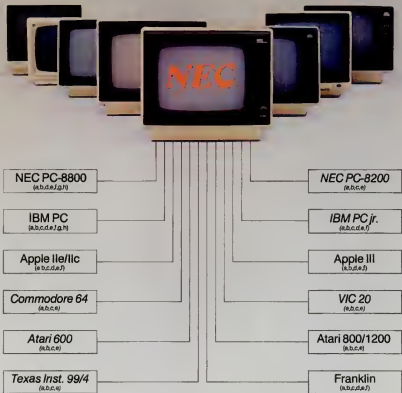
token passing: A protocol, most often used with a ring topology, that regulates the flow of information by sending around a special message to tell each station when it can transmit. Although this takes a certain amount of coordination, it guarantees that each station will get a chance to transmit at regular intervals and thus is favored for control and communications applications. The IEEE 802.4 committee is presently developing standards for token-passing networks.

topology: The arrangement of pathways, and therefore the flow of information, on a network. The most common are rings (where messages pass through each station in turn), stars (where messages pass through a central node), and buses (where each message is presented to all nodes).

twisted pair: Two wires that have been wrapped around each other, thereby lessening any tendency to pick up electrical noise. Many telephone circuits are twisted pairs, and the term is often used loosely to refer to a local telephone circuit. Twisted pairs are the least expensive type of wiring and can be installed easily with a screwdriver. On the other hand, they cannot carry data at rates as high as coaxial uses and are more susceptible to interference. Shielded twisted-pair wiring is popular for network use, with most of the cost and ease of ordinary twisted pair but adding greater noise resistance and higher possible data rates.

user PC: A work station on the network available for running user programs.
—Steve Rosenthal

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CIRCLE 171 ON READER SERVICE CARD

Network servers handle a network's commands and functions, controlling the speed, security, and convenience of the entire system.

Networks At Your Service

Nat Goldhaber and Winn L. Rosch

Your PC gives you complete control. Every command you give—every byte that's stored—is easily in reach of your fingertips, locked safely inside the stamped metal case of your computer. But once you link up with a network, you lose that intimate control over your data. In one giant act (and leap) of faith, you put all your trust in the network. It becomes the ultimate judge of the fate of your data. Exactly how much you give up—and what you get in return—are determined by the structure of the network you use.

The foundation on which most networks are built usually consists of one or more special computers that handle most, if not all, of the network commands and functions. Because these special machines exist primarily to service the requests of the other PCs in the system, they are usually called *network servers*.

The role of the network server is so important that, for the most part, how it functions in relation to your PC defines the speed, security, and convenience of the entire network. Hence, knowing the difference between the various types of servers is essential to an understanding of how

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networks operate and to deciding what network will best suit your needs and your budget.

Servers are classed in several different ways: as *disk servers* or *file servers*, depending on how they interact with your computer's operating system; as *dedicated* or *nondedicated* servers, depending on their role in the network and their individual operators; and as *central* or *distributed* servers, depending on whether one or more machines are used to service the network.

The first classification determines how the network works and the kind of software it runs; the second division has a more limited effect—it may be merely a matter of convenience for the server's operator—but can influence both the speed and cost of the entire system; the third grouping can affect both cost and convenience.

Software Serves Control

When you're working on a PC that is not connected to a network, all the commands you give and all the processing and storage are handled locally in the machine. For the most part, your interaction with the computer system is controlled by the disk operating system (DOS). It interprets your commands, handles disk storage, and generally oversees the entire system.

But DOS's control is limited: The DOS program itself (through Version 3.0) is designed to control only a single computer, and it never reaches beyond the confines of the circuitry of your computer. Under DOS, your disk drives are under your control and inaccessible to others. Moreover, disk drives in other computers are inaccessible to you.

Once you join a network, however, much of this changes. As soon as you "boot up" into a network, its controlling software adds extra routines to your computer's operating system to allow your machine to interact with the rest of the

network. Whether the servers are disk or file is determined primarily by the form of the networking software, specifically, how the software decides which commands to process locally and which to send on to the network.

In general, the networking software module (for either server type) resides as

A disk server, the simplest form of network structure, is little more than a hard disk that can be accessed by more than one computer.

an adjunct to your operating system. Like DOS itself, the networking module operates in the background, constantly monitoring the goings-on inside your computer. It checks to see if any particular activity of your application program requires reaching beyond the PC and communicating with the rest of the network.

When a local request is made, it's passed intact directly to your local machine. However, when a request is made that requires network activity, the network software sends the command to its designated target (or remote) machine for processing. The major difference between server types is whether the network software processes your commands before or after they get to DOS.

The Disk Server

A *disk server* arrangement is the simplest form of network structure; in

essence, a disk server is little more than a hard disk that can be accessed by more than one computer linked by the network. Network requests are handled by each individual workstation exactly as they would be by a disk drive in a single-user computer. Usually, the shared hard disk appears to the individual workstation in the system as nothing more than another disk drive letter, just one more storage device that files can be sent to and retrieved from.

Using this kind of network is just like having an additional disk drive attached to your machine. If you are working on a spreadsheet program, all you need to do is direct your SAVE command to the shared disk drive, and it is automatically sent to the hard disk.

The software required in each workstation for a network using disk servers is neither very different from nor more complex than that used for adding dedicated hard disks or even RAMdisks to an individual computer. An additional subroutine called a "device driver" is loaded into memory. Essentially, it tells your computer how to use and access the distant disk drive. As far as the individual computer is concerned, the remote disk drive operates in the same way that it would if it were local—that is, when you access the remote hard disk, it is under the control of your individual workstation's disk operating system.

Hence, in the disk server implementation, DOS remains in control. The software structures that DOS needs to command your own disk drives—all directories and the *file allocation tables*, or FATs (which determine and organize exactly where each block of data is stored on the disk), plus those used in operating the network—are handled locally.

The network device driver's task is to make a remote resource operate in conjunction with these local data structures. The local computer's DOS processes the

necessary information from the FAT to find the location on the server's disk where the information it needs is stored.

Although the permanent copy of the FAT is recorded on the server's disk, the data in it must either be sent down the network when the workstation needs to find a block on the disk, using up network time, or a copy of the FAT must be stored in the workstation's memory, consuming additional memory in each workstation.

Normally, PC-DOS, unlike some operating systems, keeps a copy of the FAT in the computer's memory to speed disk access. Otherwise, the disk drive would be required every time the computer needed to read a FAT entry. It would have to use the FAT to find a cluster of data on a disk, skate across the disk to that cluster, then move back to the FAT to find the next cluster, and so on.

The FATs Domino Effect

A problem can arise when several computers work on the same file. Each workstation reads its own copy of the disk FAT into its own memory when it starts to work on the disk. Each station updates its copy of the FAT independently in its own memory, so it's likely that each computer will create a different FAT. When each computer writes its copy of the FAT back to the disk, it will be unaware of the changes made by others in the network. As each workstation rewrites its own copy of the FAT back to disk, the changes previously made in the FAT by other computers can be overwritten and lost.

One common method of minimizing this problem and adding flexibility to disk server networks is to divide the server's hard disk into several "partitions" or "user volumes," each of which, though only part of a single physical hard disk, acts as an independent logical disk to the network. These partitions can be of a fixed or variable size, usually within some size constraint, if only DOS's normal 33-

megabyte volume limit. In some systems, the size of each partition can be varied (usually during installation), while in others it is predetermined by the network manufacturer.

The volumes (partitions) are allocated to the workstations in the network. Usually, each workstation gets one or more private volumes, the data in which can be changed only by that workstation, eliminating any conflicts. Public volumes are shared by a number of workstations.

Some public volumes are read-only: They cannot be changed by the individual workstations, only by an authorized network overseer or network manager, and usually only at the network disk server computer itself. Read-only public volumes are generally used to provide unchanging databases and common access to programs to be shared by all network users.

Read/write public volumes are shared by a designated number of workstations in the network or by all of them, and they can be changed and updated by any of the workstations granted access. These volumes are generally used for common databases that need to be independently revised by different workstations. However, without some means of guaranteeing only one workstation at a time access to each file in the volume, the files in a read/write public volume can be corrupted.

Disk server networks vary primarily in the amount and form of security used to prevent simultaneous read/write access to a single file. In general, they limit the network so only one workstation can use a file at a time, and any others needing access to that file must wait their turn.

The File Server

A file server network is more sophisticated than a disk server network. Although the hardware needed to run a file server network is more or less the same as that of a disk server network, the network soft-

ware is much more complex and flexible. Instead of the network appearing to each workstation as additional disks, the workstations access the network via individual files (hence the name).

Just as with a disk server network, a file server network adds an additional software module to the workstation's operating system when it is first booted up. Rather than operate under DOS's control, this additional software acts as a shell that filters all requests made to the operating system. These requests are intercepted before they ever get to your computer's operating system; hence, the shell effectively controls DOS.

Once the networking shell is in control, it passes requests that can be handled locally through to the operating system to be serviced normally by the local machine. However, requests for a remote resource (the hard disk on the file server) are sent directly to the network and never get to the local machine's operating system at all. The network routes the commands to the file server, and they are fulfilled by the server's operating system.

In the file server configuration, the local workstation only requests a file; the server hunts through its own FAT to find the individual data blocks. The server always "knows" the status of a given file. Consequently, two or more users can share the same file. The instant one user makes a change, the server's FAT is updated. Since all users working on that file use the same FAT, it is updated for everyone much more rapidly than is possible in a disk server.

The file server structure leads to some obvious system efficiencies. Because all of the necessary file structures do not need to be repeated, less memory is required at each workstation. A database can be simultaneously shared by multiple workstations. Partitioning of the hard disk is no longer necessary; the entire hard disk can be used by each user. All of the areas can

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be designated as common and written to or read by all.

Practically speaking, of course, you may not want everyone to get into everything on the disk, so in real-world network systems, network vendors generally provide utilities to assign privileges to users that may block or allow their access to sensitive files. Nevertheless, file servers provide much more flexibility than do disk servers.

Multi-Operating System Networks

Because personal computing standards are continually changing, it's important that any network be flexible enough to adapt to those changes and embrace a variety of standards, particularly among operating systems. Through the years, a business may acquire several computers, each having allegiance to a different standard—perhaps one of the three current versions of PC-DOS, or even MS-DOS, CP/M-80, CP/M-86, the UCSD p-System, TRS-DOS, Apple DOS, TurboDOS, UNIX, XENIX, Oasis, or PICK (to name but a few!). Fortunately, networks have several ways to link different operating systems.

With disk server networks, perhaps the most straightforward way is to partition the hard disk for different operating systems. Because each volume is separately under the control of a workstation, it can be managed as required by the particular operating system used by that workstation.

Although such a system can allow several workstations, each with its own operating standard, to share a common resource such as a printer, simple partitioning offers no meaningful way to share data between different operating systems in real time. File structures may be translated between operating systems to share information, typically through a program that reads a file from one partition and writes it to another, a time- and disk-intensive task. Hence, networked comput-

ers running different operating systems can never access the same file simultaneously on a simple partitioned system.

Moreover, support among a large number of different operating systems is rarely achieved in practice. Each individual operating system requires special network software for both the workstation and the disk

Networked computers running different operating systems can never access the same file simultaneously on a simple partitioned system.

server. Every time a new operating system is added, new programs for both must be written.

Networks based on file servers can be more flexible. The operating system used by the server can be specially written to understand the commands and structure of the different operating systems used by all the workstations in the network. The commands used by the server then form a superset of the commands of each individual workstation. Through the server's operating system, workstations can share files created by other machines that use different operating systems (provided, of course, that both the requesting machine and the file use the same data structure).

File servers can also be the basis of a more advanced approach, in which one or more servers uses a sophisticated universal operating system capable of understanding and handling the requests from all the workstations in the network. The software

at the individual workstations translates their network requests into the common operating system, and the server then services those requests. Any file on the server can then be used by any computer in the network in real time. Moreover, adding additional operating systems to the network's repertory is merely a matter of writing new software for that operating system to communicate with the server's operating system.

Understandably, such networking software must be complex, but its rewards may prove to be worth the effort. Using such a system, you could store the files of a Macintosh-based workstation on the hard disk of an IBM XT. The file would appear in the directories (or catalogs) of both machines and be accessible to each one whenever needed.

Such a network makes it possible for specialized assembly-line process controller computers (robot controllers) to be integrated with computers in, say, the credit department, inventory control, payroll, and shipping. Each department would have the type of computer best suited to its needs, running software specific to its function. By having the software and databases functionally distributed among several stations, the network's speed and efficiency can be enhanced. In fact, a network of low-cost personal computers organized in this way might take on the power and speed of a mainframe.

Dedicating the Server

Network disk or file servers may be dedicated or nondedicated. A dedicated server does nothing but perform the network functions it is dedicated to. Although it may be a computer in its own right, it is not used as a workstation for general data processing. Conversely, a nondedicated server operates both as a network server and as a workstation on the network, capable of running programs locally and sharing its files with the network.

A network with a dedicated server requires an extra piece of hardware—the server itself—that the nondedicated server system doesn't. Consequently, a network with a nondedicated server can cost less than one with a dedicated server; essentially, you need one less workstation, because the server does double duty.

A nondedicated server, however, is not a free bonus that comes without penalty. The server must divide its disk and some of its microprocessor's time and power between the network and its individual user functions. Consequently, its performance as a workstation may be diminished, perhaps substantially.

This is because nondedicated servers tend to be ordinary single-user, hard disk-based computers, such as an IBM-XT, which has an 8088 microprocessor that lacks enough horsepower to carry on several jobs simultaneously. However, if traffic is light and the server's operator is not impatient, performance can be sufficient.

Choosing who uses the server can be paradoxical. Usually, the server is the most powerful machine in the network—the one with a hard disk drive—and its operator is usually the network manager, who oversees and controls the network. Often the most experienced operator on the network, this "power user" demands the utmost in performance. As a workstation, however, the server may be the slowest-performing machine in the network on CPU-intensive tasks—not a good choice for a power user.

A nondedicated server can become a dedicated server merely by not using its workstation capabilities. However, specially designed dedicated servers may incorporate faster or otherwise more powerful microprocessors than those of a single-user computer. In general, a special-purpose dedicated server gives workstations faster access to networked files and is a good choice for applications subject to

very heavy disk use (lots of people accessing the single hard disk at the same time for, say, sorting or indexing a database).

Distributing the Server

The simplest form of network is called a *central server* network; it has a single server at the center of a logical (or physical) "star." In effect, the cable and data channel from each workstation lead directly to the server (perhaps as part of a bus), and all network activity is carried on with that server. Both disk server networks and file server networks may be—and most often are—arranged in this manner.

The centralized server configuration—reminiscent of mainframe operation, in which many terminals are attached in a star to a single powerful computer—functions well for many applications. Speed of operation is determined by the ability of the central server, and it can be quite high. A dedicated central server should be able to handle many simultaneous network requests efficiently. Moreover, one centralized server makes it easier to control system security. In fact, even the server hardware itself can be protected against unauthorized use and access.

The centralized server does have some theoretical disadvantages. Because all stations depend on the function of the central server, the whole network can be crippled by a single equipment failure in the server. If the server's hard disk is damaged and adequate backups are not kept, the records of an entire business can be irretrievably lost.

In some centralized server systems, only the disk resources of the server are capable of being shared. For two workstations to exchange a single file, the network must first send that file through a public read/write volume on the server. Special hardware resources of particular workstations, such as printers or modems, often are not directly accessible by other workstations. Direct communication between

workstations may not be possible.

Many networking systems permit multiple servers to share the same bus so that more than one hard disk server can be accessible to each workstation at the same time. In principle, such an arrangement should distribute the necessary disk input and output operations more evenly and thereby speed up network operations. There is also strength in numbers, and the chance of all the servers crashing simultaneously is minuscule.

True *distributed server* networks—sometimes called "peer networks" or "serverless networks"—put all workstations in the network on the same footing: All can function as file servers and share their printer and other resources. Even data on floppy disks can be shared. (Although some networks, such as AST-PCnet II and Orchid's PCnet, do allow you to share floppies, it may not be a desirable thing to do. With any removable-medium storage device, you can never be certain that the medium you want is loaded and ready.) Needless to say, should one of the individual server-cum-workstations on the network fail, network activity would hardly be affected.

Distributed server systems have disadvantages as well. There is a minor penalty in hardware cost, since to operate as a server, each machine must be equipped as a server, which requires every machine to have enough additional memory to accommodate the networking software. In addition, network security may be more difficult to maintain than on a centralized server system.

As with computing in general, no one type of networking system best suits all possible applications. Finding the optimal system requires that you match your needs to the abilities of the available products. Learning how each system works, with its particular advantages and limitations, is only the first step in a long decision-making process. ■



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Leading the PC market for LAN software, Novell's NetWare lets you rest easy in a shared environment, knowing your files are safe and sound.

The Novell Solution

Robert Cowart and Steve Rosenthal

Just as independent software companies have produced most of the significant operating systems for personal computers, one independent company seems well on the way to becoming the software leader of the personal computer market for local area networks. The company is Novell, and the software is NetWare.

NetWare is popular because of its power and speed as well as its features and functions, which are comparable to those of software for mainframes.

Its attention to such details as screen presentation, user interface, and security considerations, and its sophisticated file-sharing capabilities distinguish NetWare from other local area network (LAN) software packages.

NetWare's most serious shortcoming

(soon to be resolved, as described later) is its inability to support more than one server per network. Other drawbacks to the software include its lack of any support for distributed use of a modem and of data communications gateways to larger systems.

Ten system-specific versions of NetWare are currently available, for Gateway Communications's G-Net (the same as Quadram's Quadnet VI), Proteon's proNET (the same as Quadnet IX), TeleVideo's Personal Mini, Corvus System's Omninet, 3Com's EtherLink, Orchid Technology's PCnet (also sold by Santa Clara and AST), Davong System's Multilink, Nestar's PLAN 3000, Standard Micro Systems's SMC net, and Novell's own network, NetWare/S. Three networks come bundled with NetWare: TeleVideo's Personal Mini

NETWORK INTRODUCTION

and Quadram's Quadnet VI and Quadnet IX.

The system/user interface is identical on all systems with differences only in the hardware "drivers" (the part of NetWare responsible for communicating with each manufacturer's network interface boards). We tested NetWare in all its versions and found that it operates consistently across all the networks.

A True File Server

Only two of the various LAN software packages we tested implement a true "file server" (as opposed to "disk server") architecture. NetWare is one of them. (The other one was Nestar's PLAN 3000.) This means that NetWare uses its own proprietary file structure rather than the standard, more limited PC-DOS format. As a result, NetWare gives you a higher level of control, data integrity, and security than do conventional DOS-based PC networks, even though a NetWare system appears to be almost completely DOS-compatible.

One of the quagmires NetWare helps eliminate is that of maintaining the integrity of your files in a file-sharing environment. (See Dean Hannotte's article on file sharing in this issue, "Where Are Your Files?") When two or more users are accessing the same file simultaneously, a network needs some way to ensure data integrity. Typically, networks use file, directory, and record "locking" as safeguards. The other network operating systems, with the possible exception of Davong's Multilink, claim to have a file-locking method, but close examination reveals that they merely employ a traditional DOS "semaphore" scheme that puts a "flag" in a file's directory whenever you open a file. If the program you are using doesn't look at the flag and do something about it, or if you choose to ignore the error message the network operating system sends to your station, you may accidentally ruin someone else's data

or text files.

But this is not the case with NetWare. Whenever you copy a file to the network server hard disk using NetWare, that file is assigned the status of "nonshareable read/write" by default. This means that only one program and one user can have the file open at a time and read from or write to that file. If two people try to use the same file simultaneously, NetWare automatically prevents a data collision on the disk by warning the second user that the file is already in use (the implicit file-locking procedure).

One of the quagmires NetWare helps eliminate is that of maintaining the integrity of your files in a file-sharing environment.

Compatible with Other Software?

The issue of which popular applications programs will run properly under NetWare is important to many users.

Most popular business software packages we tested, with a few notable exceptions, performed well in single-user mode. Several allowed multiple users. And none brought down the network. In fact, crashing a NetWare system by running any kind or combination of programs was a rare occurrence.

In our first test of these programs, WordStar ran without any serious hitches. When we tried to corrupt a text file by editing it simultaneously from two workstations, neither user's changes were

saved, and NetWare marked the file "read only." This thoughtful feature alerts users to the problem before they attempt to do any more editing.

The second test looked at *dBASE II*. The program "toughed" a few times until we executed Novell's special CPMON command, which smoothed things out, at least in the single-user mode. Novell deserves praise for developing this command, which allows NetWare to deal with some quirks in programs carried over from the 8-bit CP/M world. A second user then started *dBASE II*, but an attempt to use the same database still in use by the first workstation was denied by the network (as expected). We could access different databases running the same copy of *dBASE II* at the same time, but since the test database was marked nonshareable, the network kept the second user out—the appropriate action.

Next we invited disaster by flagging the database as being shareable. The program ran normally and allowed concurrent access to the data by two users. Both users then made changes independently to some of the records, quit *dBASE II*, reloaded it, and looked at the database again. The new version clearly showed that the changes of the second user to sign off after the update prevailed, presumably having overlaid those of the first user.

We installed *Framework* quickly, using its documented hard disk procedures, which are appropriate for networks.

Our test consisted of two *Framework* users editing the same word processing file concurrently, and here we hit a snag. It made no difference to *Framework* or to NetWare whether or not the file was shareable and whether or not we had used CPMON. In all cases, the second *Framework* user could load and edit a file already in use, and no error messages of any sort were displayed. Whoever saved work last prevailed. Clearly, a hole in the *Framework*/NetWare interface allows *Frame-*

work to bypass NetWare's file-status checks.

We then experimented with *LAN:DataStore*, a true multi-user database manager. With our name and address database set to shareable read/write, we had no difficulty editing, deleting, and appending the file from several workstations simultaneously. Everyone could see the changes shortly after they were made.

Contrary to the claims of some experts that are based on a few incompatibilities with existing software, the NetWare operating system does not modify standard PC-DOS in any way. In fact, each workstation is booted with standard DOS from a floppy disk. After this, a section of code that Novell calls the "shell" is loaded. The shell sits immediately above the resident part of *COMMAND.COM* and DOS and simply intercepts all DOS calls (interrupt 21s), distinguishing between requests for local drives and those for network drives.

It passes local drive requests through to DOS as usual. Network drive requests are processed into a packet, sent to the server, and serviced there. When it receives the requested data, the workstation's shell "unpacks" the information and passes it through to DOS or to the application.

Some programs just won't run on a NetWare server (*ProKey* and *Flight Simulator* are two examples). The reason lies in NetWare's architecture. The NetWare operating system spends some time servicing DOS and some running NetWare itself. When it's running NetWare, the operating system controls some of the server's hardware completely, for short periods of time (the keyboard, some I/O ports, and certain segments of memory, for example). When it's servicing DOS, NetWare actually puts itself to "sleep" temporarily, allowing DOS to do local processing. If during that time a program performs some direct input/output through hardware or makes

direct ROM BIOS calls, NetWare may not find what it expects when DOS gives up control again. Any program that does not use DOS to do its input/output will meet with unpredictable results in the NetWare environment.

Extensive Security

Security is an important issue in any network. Novell's NetWare offers by far the most extensive data security system we have seen on any of the networks, maybe more than all the others combined. Novell uses a proprietary disk file system that offers more "locks" than DOS does. NetWare allows control down through the file level. Most of these locks are optional.

There are four possible levels of security: logon/password, trustee, directory, and file. Logon security is mandatory, but passwords are optional. Your logon/password gets you onto the network. Once there, your trustee level determines whether you can read, write, open, create, or delete files, search the directory, or modify file attribute flags. Directory rights determine which directories you can see, and file rights determine which files you can change and which you can't.

Security is also assignable on a group level. Say you want to install a new set of files for your data entry staff. The network manager can set access and security parameters for these files with a single command.

Most importantly, without the NetWare operating system, the data on a Novell formatted hard disk is virtually impregnable. Booting DOS in the server XT when no one is looking won't give you access. You must also boot NetWare and enter a password and logon code along with the correct rights.

Directories and Volumes

NetWare gives you the flexibility of "dynamic volume allocation," an important resource for managing shared hard

NetWare Flexes MUSCLS

NetWare's not only smart, it's also strong—thanks to a system called MUSCLS.

The Multiple Users Software Licensing System (MUSCLS) is a scheme that Novell has built into NetWare to allow applications developers to key their software packages to a particular network, preventing their programs from running on other networks and thereby discouraging copyright infringements.

Such a scheme is possible because each network has a hardware serial number embedded on a "key-card," which must be inserted into a slot in the XT server before NetWare will operate. Programs can be internally "stamped" with this same number and modified slightly to compare the serial number in

the key card with its own number.

Another protection scheme allows files to be marked "execute only," meaning these files will run but cannot be copied. And since NetWare is smart enough to know at any point just how many people are using a specific file, it is also capable of preventing more than a specific predetermined number of people from using the application simultaneously. Therefore, a developer, instead of relying on the good will of a network owner to buy as many copies of a program as there are users, can sell a pre-encoded version for a specific number of users, upgradeable as the network grows.—R.C. and S.R.

NETWORK INTRODUCTION

disk resources efficiently. It assigns hard disk space to each user the way DOS manages subdirectories. The size of each subdirectory on a standard DOS diskette is dynamic, changing as files are copied to or erased from it. In the same way, as long as NetWare's hard disk has some unused space, it's first come, first served.

The server unit can simulate as many as 26 drives (A: to Z:) per workstation, but provision must be made for any local drives the user wishes to access. For example, a typical user station may have a couple of floppy drives and a RAMdisk, for a total of 3 local volumes. These volumes would take precedence and thus diminish by 3 the 26 logical drives available through the network.

Sophisticated Printing

Novell's print spooler offers unmatched flexibility but at the cost of somewhat clumsy operation. In addition, even though as many as three printers are allowed (two serial and one parallel), they must all be connected to the server. NetWare does not support the sharing of printers connected to user workstations.

On the positive side, NetWare has a fully implemented command spooler like those found on larger systems. A command spooler is the program in the file server that controls the sharing of printers and the priorities of printouts. It can route the output of a program or application intended for printing directly to a disk file. With NetWare's command spooler, when your program is finished, you type in a single command; the file is then closed, sent to the spooler, and printed.

Other spooler options include printing a banner page before each job, printing multiple copies of a document, changing paper during printing, checking to see which print jobs are pending (on the queue), reorganizing the order of the queue, and redirecting a document to a different printer. This printer control command set is the

most complete of any network that we tested.

Of course, the tradeoff is the increased obtrusiveness of the system. Though the manual and the help facility both explain each command in understandable terms, the trouble is that there are so many commands, often with only subtle differences. Since the documentation gives no overview of them all, making a reasonably accurate guess as to which one to use in a particular situation can be tough.

NetWare gives you a great deal more power over most aspects of system operation than do other LANs. You cannot, however, use certain DOS commands without producing undesirable effects.

Limitations

With NetWare, you have a great deal more power over most aspects of system operation than with other LANs. However, the flip side of this extended functionality is that, according to the Novell manuals, you cannot use certain DOS commands without producing undesirable effects. These commands are PATH, CHDIR, BACKUP, ASSIGN, PRINT, and CHKDSK. Getting used to this quirk may take a little time, but in all cases, equivalent (or better) features are available within NetWare.

Another issue is hardware compatibility. Since NetWare is a proprietary operat-

ing system, other manufacturers' hardware usually will not play ball on the network. Plugging in a Tallgrass or Alloy backup unit and expecting it to work will leave you disappointed. Novell does write "ports" for some of the more popular add-on hardware products, however, and so if this is a concern for you, a phone inquiry may be in order.

Documentation

The voluminous NetWare documentation is at best hard to digest. Generally speaking, all the necessary information is included, but in a form closer to that of a technical treatise than that of a user's guide. Vast improvements could be made in the overall organization, and an index would certainly be appreciated.

Included are a lengthy overview, an installation and "getting started" section, descriptions of user commands, error messages, and a 14-page glossary.

A user handbook describes how to operate a workstation on the network, and a system guide, intended for the system supervisor, gives all information necessary for installing and operating the network. Also included are an extensive programmer's guide and a technical reference manual.

On-line documentation in the form of numerous Help screens is well executed, taking advantage of the IBM block graphics. Though not excellent, on-screen help gives you enough information so that you don't need to refer to the user's guide in most cases.

Based on both our benchmarking tests and our features evaluations, one recommendation seems clear: Whatever hardware you pick for a network, you should consider NetWare as an alternative to the supplied operating system. If you are looking for more security, wouldn't mind learning some additional commands, and could use the extra speed, NetWare merits your serious consideration. ■



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CIRCLE 166 ON READER SERVICE CARD

An Inside Look at IBM's LAN

Sammons & Associates/Tim Sammons,
Stan Clark, Tom Schnetlag, Jim Head

Reviewing the new IBM PC Network is a bit like examining a new automobile that's missing some salient parts, such as the steering wheel, gearshift, and the body. The heart of the network is available now, and we can describe its general performance characteristics, but, until the supporting software is released in early 1985, we can only speculate on the final appearance and attractiveness of a soon-to-be complete system.

We'll describe the IBM PC Network hardware in this review—its important features, the methods of implementing these features, some of the trade-offs that IBM made in this product, and how well it performs in its current incarnation. Along the way, we'll consider some of the general features of local area networks and how they relate to the choices IBM has made.

Without the supporting software, we can't judge the ultimate usefulness of the IBM PC Network for the end user. We can't describe, for example, precisely how IBM plans to support the sharing of peripherals such as hard disks and printers until we examine the *IBM PC Network Program*, to be released in early 1985. Nor will we be able to describe the operating system's network support until PC-DOS 3.1 becomes available (also in early 1985). But the PC Network hardware we have before us is plenty interesting and warrants close examination, so let's get started.

What Is It?

The IBM PC Network connects up to 72 IBM PCs, XT's, Portable PCs, and AT's (hereafter collectively called PCs) through standard broadband coaxial cable, the same medium used for cable TV. By using

a broadband cabling system combined with architecture open to software development, IBM has opened the door to innovations such as linking PCs to voice systems, telephones, and energy-management systems for buildings, and even video transmissions, all in a network. You should be able to connect to the PC network other microcomputers that supply a strictly IBM-compatible BIOS and are physically bus-compatible with the IBM PC. This probably excludes many so-called PC-compatibles and the network doesn't support the PCjr at all.

Using this local area network, you can pass files and messages between computers and share hard disks, printers, and other expensive peripherals among several PCs—as soon as the supporting software becomes available. In the meantime, the *IBM PC Network Technical Reference Manual* (number 6322505) supplies instructions on developing programs in assembly language to access the network, but this manual is meant for software developers, not end users. In fact, some applications software developers won't wait for IBM's software to appear before they begin developing their own; the available hardware and the technical reference manual are enough to get started building dedicated distributed applications.

Getting Started

You need three packages of hardware components to set up the minimal IBM PC Network: one IBM PC Network Translator Unit for the entire network; one IBM PC Network Adapter for each PC on the network; and a selection of IBM PC Network cable kits to connect the various components. We will discuss the purpose and function of each of these hardware components in detail later, but for now take a look at the upper portion of Figure 1, which shows a small network using a translator unit, a single network adapter, and the component parts of each kit. (In-

IBM's new PC Network lets you pass files between computers and share hard disks, printers, and other peripherals.



IBM PC NETWORK

struction booklets also come with each kit; two useful wrenches come in the translator kit, and the adapter board has a diagnostics disk.) The minimum IBM PC Network supports as many as eight PCs, each of which may be up to 200 feet from the eight-way splitter via optional IBM cable kits.

To expand the network to encompass from 9 to 72 PCs or to support distances of up to 1,000 feet between PCs and the translator unit, you need an IBM Base Expander Kit plus a combination of short distance, medium distance, and long distance cabling kits. The whole of Figure 1

The base expander supports up to 64 PCs, besides the 8 already connected to the basic network.

shows how to connect these kits to the basic network. The base expander connects to the expansion tap on the T-connector that comes with the translator unit, and provides eight more cable taps.

To each of these taps, you connect a short (1-foot), medium (400-foot), or long (800-foot) distance kit, each of which has another eight-way splitter, to which you connect the network adapters by a cable up to 200 feet long. Thus, the base expander supports up to 64 PCs, besides the 8 already connected to the basic network. (You can't directly connect PCs to the base expander except with a test tool that comes with all three kits. Moreover, you can't connect an expansion kit directly to another expansion kit.)

It takes longer to explain the connec-

tions than to hook up the network. Figure 1 shows the network's flexibility. A maximum diameter of 2,000 feet for the entire network is rather small, but if you can live with this restriction, you can choose from a wide variety of possible configurations.

If you want a network with more than 72 nodes, you (or your consultant) can design a cabling system different from IBM's. In addition, you will need a different frequency translator if the network is to extend more than 1,000 feet from the base expander or if you want to add more than

LAN FACT FILE: IBM PC NETWORK

Marketed by:

IBM Entry Systems Div.
P.O. Box 1328
Boca Raton, FL 33432
(800) 447-4700

Retail Prices

Translator Unit	\$595 (8 stations)
Workstation	\$ 695
Server Station	N/A
Dedicated Server	N/A
Cable (per foot)	50¢ to \$1
Connector	\$59 (8 units)
Repeater	N/A
Four-Station Configuration	\$ 7,770

Hardware Capabilities

Configurations:	
No. Servers	2-1,000
No. Workstations	1-1,000
Server Type	XT
Memory Min./Max.	
Dedicated Server	256/640K
XT Server	256/640K
Workstation	128/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>

Backup

Vendor Supplied	<input checked="" type="checkbox"/>
Disk	<input checked="" type="checkbox"/>
Global?	<input type="checkbox"/>

Network Description

Architecture	Bus
Type	Broadband
Speed	2 Mbits/sec.
Server Type	XT

Security

Logon ID	<input type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:	
Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input type="checkbox"/>
System Management	<input type="checkbox"/>
Others	<input type="checkbox"/>

Applications:

Electronic Mail	<input type="checkbox"/>
Chat	<input type="checkbox"/>
Utilities	<input type="checkbox"/>
RAMdisk	<input type="checkbox"/>
Other	<input type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

256 network adapters to the net. Because IBM doesn't supply a frequency translator or cabling system for these larger systems, you will have to contact a company such as Sytek Inc., whose broadband technology is the basis for the IBM PC Network. Using Sytek's or similar equipment, a network of PCs can extend 3 miles and have up to 1,000 nodes.

Installation

Installing the IBM PC Network is straightforward. The instructions that come with each element of the network are clear and abundantly illustrated. Installing the translator unit, base expander, and a single short, medium, or long distance kit takes about half an hour. Installing the first network adapter takes no more than an hour and 15 minutes, including time to do the diagnostic tests. We spent most of that time reading the instructions; installing additional network adapters takes only about 15 to 30 minutes apiece.

When designing your network, you should at first use no more than half of the taps on each eight-way cable splitter to accommodate future growth without disrupting the system for recabling. Even if you don't intend to add additional computers, you may need free taps to connect peripherals or to access services such as voice or video communications.

In our review, we found that a few minor items in network installation could be improved. First, the connection point between the adapter and the coaxial cable is so close to the edge of the computer casing that it's hard to connect or disconnect the cable firmly with the wrenches that IBM supplies. In addition, the size of the card combined with the design of the card guide makes for a tight fit, so you must be careful during installation. We found that the card's installation and removal were much easier when we positioned the adapter card in an outside slot. Finally, the instruction manuals don't

explain the importance of saving the terminators for the eight-way splitters. The answer is that you must replace the terminators if you remove a PC from the network to maintain proper RF characteristics of the cable. Still, the high quality of the physical components' design in the network and the overall ease of installation overshadow these small complaints.

Components

We've explained the system and how it fits together; now let's take a closer look at its components.

IBM's decision to use broadband network technology sets the IBM PC Net-

work apart from most previous computer-based LANs. Networks based upon twisted-pair wiring or baseband use of coaxial cable are more common than broadband networks. (See "The Lay of the LANs" for descriptions of network elements.)

The network's broadband use of a single 75-ohm coaxial cable is exciting news because transmission of voice, data, videotex, and cable TV are possible on this network with the proper sending and receiving equipment. Process control, building maintenance, and security applications are possible too. We pay a price for this capability, however. Baseband signals aren't usually modulated onto a carrier fre-

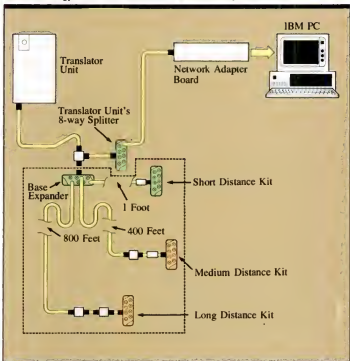


Figure 1: The upper portion of the figure shows the minimum network, consisting of a translator unit and a network adapter. The full figure shows the expanded network using a base expander and short-, medium-, and long-distance kits.

IBM PC NETWORK

quency. So baseband can avoid the cost and complexity of the broadband's conversions: digital signals to radio frequency (RF) signals, a second conversion to a different frequency, and then reversion to digital signals.

A cable like the one used in the network supplies a total bandwidth of at least 300 MHz, ranging from 10 MHz to 310 MHz or higher. Transmitted signals travel in one direction only on a single channel; separate send and receive channels are used for two-way communications. Transmissions in the network between the adapter and the translator unit use 6 MHz of bandwidth in each direction, leaving more than 96 percent of the total cable bandwidth available for other uses.

It remains to be seen, though, how the other channels on the network will be used and whether these potential applications will give the broadband network a technical advantage. Reception of video signals or other types of transmission on the network will require a different, non-IBM frequency translator unit and perhaps a new interface board. Still, network users who want to add video or other features to their networks will already have the nodes and cabling in place; upgrading will cost less on a broadband network than on a baseband network.

Network Topology

Local area networks have one of three basic network configurations or topologies: ring, star, or bus. The IBM PC Network, although physically laid out as a tree with the IBM cabling components described earlier, looks like a star, in which all nodes are joined at a single point. In the network, the translator unit acts as the central point that receives and retransmits all network signals from the PCs.

Other aspects of the network, however, are logically more like those of a bus topology than a star configuration. In particular, the translator unit retransmits each sig-

nal over the cable to all network nodes, instead of only to specific nodes. As on a bus, each node in the PC Network must recognize the messages intended for it. And like other networks with bus topology, the PC Network lacks a master node; each node in the network is a peer of the others.

The adapters transmit and receive on two different channels of the broadband network. One of the translator unit's responsibilities is to receive signals on the transmit frequency and retransmit them to all adapters, including the sending adapter, on the receive frequency. The translator unit receives incoming signals only at a carrier frequency of 50.75 MHz and retransmits them only at 219 MHz.

The unit doesn't support functions such

as video or voice communications; nor does it retransmit computer data at different frequencies. To use the broadband bandwidth more fully, you need a more sophisticated (and probably more expensive) frequency translator.

The translator unit's second responsibility is to maintain a balanced network. For the adapters to work correctly, they must receive data at approximately the same signal strength. The translator unit therefore significantly boosts the signal before it retransmits to the adapters' receivers.

Transmission Rate and Collision Detection

The data transmission rate across the network is 2 million bits per second, which

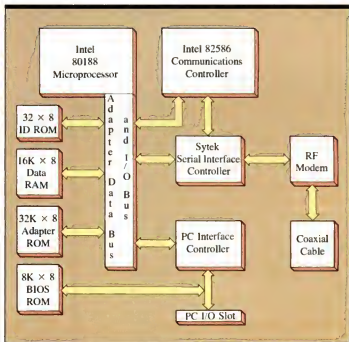


Figure 2: A block diagram of a network adapter.

may seem fast indeed to personal computer users who are used to asynchronous communication over phone lines at 1200 baud. The network uses the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) protocol to determine which node on the network uses the network at a given moment.

A key feature of the CSMA/CD protocol's implementation is that the computers involved in a collision quickly stop transmitting their messages. This failsafe mechanism minimizes the amount of network time that collisions waste. Thus, even with heavy demand for access, the network's total throughput approaches its theoretical maximum.

Adept Adapters

Nearly all of the hardware intelligence in the IBM PC Network lies in the adapters. Figure 2 shows a block diagram of an adapter.

The primary function of the adapter is to take data from the PC and process it so that it can be sent as a series of RF signals over the network. The adapter, of course, must also do the reverse: receive RF signals and turn them back into computer data intelligible to the personal computer.

The network adapter hardware and software supply the processing for five of the seven OSI layers, extending from the physical layer up through the session layer. By combining these five layers into a seamless web, the adapter eliminates the need for software developers or users to know the network protocols for the lower OSI layers. By not incorporating the sixth OSI layer (the presentation layer), the adapter remains effectively independent of the operating system. Application programs will be able to access the network whether they run under MS-DOS, CP/M-86, XENIX, UNIX, or another operating system.

The adapter's physical layer is implemented by the RF modem, which consists

of a 50.75-MHz transmitter and a 219-MHz receiver contained within a metal shield. The modem is compatible with cable television in signal level and quality, but not in signal-level tolerance.

The Intel 82586 Communications Controller and the Sytek Serial Interface Controller (SIC) implement the adapter's link layer. The SIC monitors collision detection and other carrier problems. The 82586 supplies the conversion between RF signals and digital information and arranges

The primary function of the adapter is to take data from the PC and process it so that it can be transmitted as a series of RF signals over the network.

the data into discrete packets for transmission.

The other three layers—network, transport, and session—are implemented in firmware executed by the Intel 80188 microprocessor. A set of registers in the Personal Computer/Host Interface Controller and the adapter NETBIOS (Network Basic Input/Output System) handle the interface between the adapter and the host computer. In particular, all data transmissions between the adapter and its host PC must squeeze through a 2-byte FIFO (first-in, first-out) register under control of both the adapter's and its host PC's direct-memory access (DMA) controllers. Because the IBM PC's bus is a single-master

bus, only one processor may access the bus. The transfer is actually quite efficient, taking only as much time as would be consumed by one processor copying the data from one buffer to another.

The adapter contains an 8K area of ROM which, by being mapped into some of the PC's unused address space, augments the BIOS we're already familiar with. This code handles the PC's end of all PC/adapter interactions, including calls made on the adapter by application programs or network control programs running in the host PC.

In terms of node addressability, the adapter supports two types of addressing that allow each node on the net to recognize the signals intended for it. First, each adapter comes with a permanent physical address stored in an identifying ROM. Second, up to 16 logical addresses can be stored in RAM on each adapter.

You define these addresses as common names such as John and Mary or group names such as Accounting and R&D. By storing the same group name in the name tables of more than one adapter, you can send messages to multiple nodes simultaneously. For example, you could route a message to all computers whose name table contains the name Accounting. Thus, you can establish multiple overlapping hierarchies with this flexible naming scheme.

System Costs

IBM markets the PC Network as "low-cost"; the translator unit is \$595; the single unit price of the adapter is \$695. It's worth remembering that each PC on the net must have its own adapter. Cabling costs vary with the size of your network and its physical layout. IBM has announced discounts of 5 percent when ordering three or more of the same product and discounts of 8 percent when ordering ten or more. Discounts up to 20 percent are available to educational institutions.

IBM PC NETWORK

A minimum system to connect two PCs requires one network translator kit and two adapters, for a total of \$1,985, without software. The price per computer is thus about \$1,000. If you buy network equipment for 10 or more PCs, the price per computer could be as low as \$700 if you need minimal cabling and take advantage of the quantity discounts, or as much as \$1,000 per computer if you order the adapters piecemeal and need much cabling.

Programming the Network

IBM and independent software vendors will create over time a host of software that uses the IBM PC Network. Still, some users will want to create custom applications. Fortunately, because the first five layers of the network are implemented on the adapter, creating programs for the network is fairly straightforward—if you're used to programming in assembly language.

The network's technical reference manual contains instructions on how to create programs for the network. Supplied with the manual are two on-disk sample programs with listings that will enable you to start communicating immediately on the network.

Issuing a command to the adapter is quite easy—you simply set up a network control block with the appropriate fields filled in, perform an INTERRUPT 5CH, and wait for the command to complete. The NETBIOS on the adapter handles all the other work for you: the protocols, retries, transfer of data buffers via DMA—whatever is necessary to complete the transaction. A NO-WAIT option is available for most commands, leaving you free to do other processing in parallel with the adapter; the adapter's NETBIOS will interrupt you when the transaction is completed. You can also queue multiple commands for the adapter to execute.

The command set for programming the

network is small but rich and flexible. The commands include four general-purpose commands, three for adapter address name support, eight for session support, and four for Datagram commands. You can use these commands in several ways to communicate on the network; the most efficient is with the session support commands. Using these commands, you can establish a logical connection between two

Because the first five layers of the network are implemented on the adapter, creating a program for the network is fairly straightforward—if you're used to assembly language.

PCs to use all the intelligence built into the adapter, making the job of systems programming relatively easy.

Performance Evaluation

We ran tests to evaluate the network's performance. But the results don't necessarily show what we can expect from the *IBM PC Network Program*. The reason is that neither our test programs nor the documentation's sample programs used IBM's suggested throughput-enhancement methods. We measured: the ratio of transmissions attempted to transmissions successfully completed on the first try; the time to begin and run typical applications from disk, on standalone PCs, and on PCs connected to a network server; and adapter

overhead with no disk activity present. We performed all tests on an otherwise unloaded network.

We used two configurations: a two-server, two-PC network and a one-server, three-PC network. We tested both configurations by repeatedly executing a batch file that assembled a program, linked it, displayed its listing, and displayed a directory listing. The two-server, two-PC configuration ran for 11½ hours and produced a low total of collisions, aborts, CRC errors, and alignment errors.

In the three-PC, one-server configuration running the same batch file, the adapters often locked up, refusing to respond even to the GET ADAPTER STATUS command, so we took the results from the server's adapter. We didn't try to determine the cause of these failures, but these results show that session-layer implementations should include retry logic to reset adapters under these conditions. We tried this remedy, and the adapters always recovered.

We compared typical timings for loading and running applications software in a network environment using the supplied sample server program with times for loading and running the same applications on standalone PCs. As expected, performance of the standalone PC AT is outstanding, but transfers from the AT as a file server across the network are not. The network program is expected to improve these figures substantially.

In addition we measured the overhead that the network adapter imposed while handling a transaction. This test used minimal code to get the beginning time, send the message, receive a valid response, and get the ending time. We approximated the total overhead of both adapters in the exchange to be 0.69 seconds, because the average total time of the transaction was 0.94 seconds and the 64K packet traveled at 2 megabits per second. Thus, the overhead that each adapter imposes is about

0.345 seconds.

All in all, we were guardedly impressed by the network's performance, which is reasonable, given the undeveloped state of our programs and the sample programs. Applications that use the network, including the *IBM PC Network Program*, should be able to improve the network's performance by maximizing message size (reducing adapter overhead), decreasing the number of sessions per adapter (increasing the adapter's work area), queuing multiple commands, and overlapping disk I/O with network activity.

Predictions

Independent software vendors and OEMs who want to develop their own compatible hardware and software can use this product. Corporate users probably will also acquire a few PC networks right away for a head start in integrating this technology into their data processing systems. On the other hand, large-scale corporate and small-business implementations will probably have to wait for the release of DOS 3.1 and the network software. Of significance to corporate users is IBM's announced intention to support connection of this network with IBM mainframes.

In the first half of 1985, we can expect a 3270 SNA gateway via a communications server on the network. Each server, when equipped with an SDLC Communications Adapter and the *IBM PC Network SNA 3270 Emulation Program*, will be able to support up to 12 SNA 3270 sessions while concurrently running DOS applications. When configured in the dedicated mode, each server will be able to support up to 32 concurrent SNA 3270 sessions. You will need multiple servers to enable more sessions on the network.

IBM also promises to support the future connection of this LAN with the IBM cabling system, a token-ring network using optical fiber cable, and twisted-pair wiring to support data, voice, and video

transmissions. Once this network is available (in 1986 or 1987), it will support the attachment of most of IBM's information processing equipment and will supply an interface to System 370 applications.

In addition, IBM has announced an industrial LAN that will establish communication between the IBM Industrial Computer and members of the PC line. Though the PC network will not be able to connect

The fallout among PC-compatibles will probably intensify. Only the companies whose products already run or can quickly be made to run on the IBM PC-bus compatible LAN are likely to survive.

directly to the industrial LAN, there will be an indirect connection in that the PC network and the industrial LAN will interconnect with the IBM cabling system. Furthermore, the same PC network program and NETBIOS interface will be used on both the PC network and the industrial LAN.

The debut of the NETBIOS reveals the firmware heart of IBM's short-term network strategy. This product's design makes good IBM's promise to encourage OEMs and software vendors to develop network-compatible products. Not only will the open architecture of this product be upwardly compatible with future versions, but to the degree that an application makes calls only to the NETBIOS, it will

be operating-system independent.

Already we've heard rumblings in the development community of another volcano of start-up, add-on ventures. In the next year, you can expect operating-systems miscegenation of various hues—mixing and matching of DOS 3.1, UNIX III and V, Concurrent CP/M and XENIX, and others. The multi-user/multitasking operating systems vendors are likely to stage the final battle for standards supremacy.

Many new and old applications from PC-DOS and other worlds will compete for your network software dollars. New software protection and multi-user licensing schemes must be developed. The *IBM PC Network Program* will supply some session-layer security, including passwords, IDs, and record locking, but data security has been left for later development. This probably means short-term growth in hardware security, data encryption, and security consulting. Demand for video, videotex, video conferencing, and voice add-ons to this LAN will be slow at first but probably will grow rapidly.

The fallout among PC-compatibles will probably intensify with several nonnetwork-compatible vendors falling by the wayside. Only the companies whose products already run or can quickly be made to run on this LAN (that is, those that are IBM PC bus-compatible) are likely to survive.

Incompatible LAN vendors will also probably find that the going gets rougher. IBM's entry may inject credibility and some order into a chaotic marketplace; the competition, however, will be intense. On the other hand, business for network designers and system integrators will get a much-needed boost.

Among retailers, only full-service providers are likely to profit significantly from this new product. Others will continue to see their profit margins shrink.

The IBM PC Network is an important addition to IBM's arsenal in the coming

showdown with AT&T. IBM's promise to integrate the network into its long-term mainframe network strategy makes this LAN more than simply a stopgap to preempt AT&T's UNIX and PBX systems. Big Blue's lineup is growing, and the acquisition of Rolm positions IBM firmly in the PBX-based data communications business. The network, a joint effort with Sytek, plants IBM squarely in the middle of the LAN marketplace.

IBM's recent release of home-grown applications software for the PC thrusts Big Blue into the micro-software market. These developments, teamed with IBM's dominance in other mainframe and micro-computer markets, helps solidify its position prior to any battle with AT&T.

Of course, companies such as Rolm and Sytek benefit from their association with IBM. Sytek, particularly, gains credibility, increased equipment sales, and more clients for custom broadband systems.

The IBM PC Network probably tips the balance in standards to broadband away from baseband, which was already slipping in popularity. It will be interesting to see how long PC-DOS lasts before IBM brings out its own multi-user/multitasking operating system. The odds are that IBM's multi-user operating system will look a lot like UNIX, although obviously it probably won't be completely compatible with AT&T's UNIX V. Now that both IBM and AT&T are in the LAN and PBX markets, these two technologies, though perhaps not these two companies, will probably coexist and interconnect. ■

Sammons & Associates is a computer consulting firm in Berkeley, California. It served as the computer coordinator and consultant to the Democratic National Convention committee and set up four long-line and three local area networks at the San Francisco Convention.

Looking Ahead at IBM's LAN Software

Peter Lisker and Bill Machrone

It's a rare day when you get to see any IBM product before its release date, rarer still when the product is as significant as the IBM PC Network. We were not only able to get our hands on IBM's network hardware (see "An Inside Look at IBM's LAN" in this issue), but on a beta version of the network software. Though we can't draw conclusions from a product still under development, this preview of the software gives a tantalizing look at the PC network's potential.

The IBM network is a broadband LAN using a Sytek/IBM board, with a transmission speed of 2 megabits per second. It has already created tremendous excitement in the PC community, but whether this

excitement is warranted remains to be seen. The price is low for a broadband implementation; it is easy to use and supplies a broad range of capabilities. It's a network to be dealt with seriously.

The PC community waited a long time for this product, and IBM seems to have delivered a readily usable and sophisticated network. In our initial look, we came away impressed with some aspects of the network, but the jury is still out on others.

Applications

The documentation includes an addendum of IBM-supported products that work with its network. Though IBM has made

The beta version of the IBM PC Network Program tested on the new IBM PC Network promises to set new standards for LANs.

every effort to make other packages work with its network, there are limits to what will run. This isn't IBM's fault but rather is a byproduct of some sloppy programming. For example, *dBASE II* (Version 2.41) will not run. The program's CP/M heritage causes the incompatibility, because this application uses information taken from the file control block (FCB) for I/O after it has closed the file. An appendix subtitled "Co-existence of applications with the PC Network program" states that "any application that does I/O over the network cannot use FCBs in the following ways: construct its own open FCB; save an FCB in a file and use it later in a different run; close the FCB and then continue to use it as if it were still open."

Tricks like these were popular among CP/M programmers, many of whom carried their bad habits over to the MS-DOS environment. The network can't control its files adequately when programs act this way, so now it's time to pay the piper. An application program's limit on the use of FCBs is in fact a network program restriction, rather than a DOS 3.1 restriction. The network program prefers that application programs use the file handle I/O instead of the FCB.

At last report, IBM was still working on ways to modify the program so that it will detect improper file I/O and substitute I/O calls that are not threatening to data integrity on the network. We tested the network with *dBASE III, 1-2-3, WordStar, Sidekick, Volkswriter, and Framework*.

Framework would not run on the AT server, because the AT has problems with the program's copy-protection scheme. The other programs behaved in a courteous manner. Along with these programs, IBM has announced a detailed list of IBM software that functions on the network, and the type of configurations, such as shareable, nonshareable, and so forth.

Execution and load times over the network seemed reasonably consistent with

those of the other networks we tested.

The IBM network is a multilayered affair. The BIOS on the network adapter card functions in tandem with the network program. The network program interacts with DOS 3.1 to supply system-level control for the network. The system supports remote hard disks as well as remote printer access. DOS 3.1 implements read-only protection of files, along with file sharing using file- and record-locking extended DOS calls.

The network allows extensive spooling and print capabilities, including the best print queue management we've seen. The network manages printing as a background task, allowing you to do other jobs. It also includes a nice message facility, which allows you to send messages to any or all users logged onto the system. The option of saving these messages into a file is supported from the message task menu.

Four Functional Levels

The network is designed around four levels of functionality. The network administrator assigns one of the four levels to each station depending on access needs. The simplest level is that of the *redirector*. This mode permits the redirection of file I/O and printer requests to a server machine and includes the ability to send messages. The *receiver* mode, which includes the *redirector's* functions, allows the receipt of network messages and the routing of the messages to the printer, console, or a file. A machine in this mode can receive messages while it executes local programs.

Next on the hierarchy is the *messenger* mode, which adds a full-screen editor and lets you forward messages to multiple users. You can alternate between the application and the full-screen network mode. The final level in this scheme is the *server*. At this level the machine can share its resources (via the NET SHARE command or through the menus), whether hard

disks or printers, while working on local applications. As expected, the higher-level modes require more memory.

The network shares subdirectories on one or more servers among multiple users, assigning different access rights to each user. Server printers may be shared via the network program. Each server can manage up to three printers at once, each separately addressable by network users. Files sent to these printers are put into a print queue, which may be managed by the server or displayed by the remote users.

Because the IBM network shares disks, directories, and files, it can control access to them. The network supplies the following types of access:

- Read only (R)—allows for read only access.
- Read/write/create (RWC)—provides for the ability to read, write, or create within the disk or directories.
- Write only (W)—provides for write only access to a disk or directory.
- Write create (WC)—provides for both write and create rights to a disk or directory.
- Read/write (RW)—allows for read and write rights to a disk or directory.

These attribute rights may be changed by the DOS "attribute" (ATTRIB) command on any file. The system administrator establishes the rights to a subdirectory, and the user can't change them.

The network program prohibits you from using DOS commands that either conflict with network operations or threaten the integrity of other users' data. These commands are forbidden in an IBM network: CHKDSK, DISKCOMP, DISKCOPY, FORMAT, FDISK, PRINT, RECOVER, SYS, VERIFY. Appropriate network commands replace these commands, so there is no overall loss of function.

Passwords control access to files and subdirectories; password protection is also available on shared printers. The record-

IBM PC NETWORK

locking task still falls to application programs. When the programs fully use the network's capabilities, they can control access right down to the field level (even if it's 1 byte long).

Performance

The software's developmental nature and the applications limited the performance of our beta version of the IBM network. Most applications open their files in read/write/create mode, but don't make any of the available calls for shared access over the network. The network manages these applications by forcing them into serial access mode so that users don't conflict with one another. If the program is modified so that files are read-only, the software gives full, simultaneous access to those files, without serialization. And speed increases dramatically.

dBASE II would not run because of the FCB problem noted earlier, thus dooming our chances to see how the network performed in our productivity environment. Because the *LAN: Datastore* program has not yet been ported to the IBM network, we couldn't run our standard multiuser database environment. That left us the development environment as the only one that would successfully run under the IBM network.

Our conclusions based upon this one environment aren't definitive, but a few things stand out. The single-user times for the server (AT) are spectacular, mostly because of the AT's speed. Our tests show that the limiting factor in the network is not the network hardware, but the software. Again, we stress that the network program we used was a preliminary version. Pre-release versions of products are often notoriously different from their final versions. By the time IBM formally releases the product, the company will probably have tweaked the performance to bring it into the faster segment of the market. All in all, the performance of the IBM network

seems adequate—nothing to write home about yet, but with clear potential.

Installation

IBM has a utility program called Installation Aid to simplify installation. Unfortunately, the utility wasn't ready when we tested the network, but even without it, installation wasn't that hard.

By the time IBM formally releases this product, the company will probably have tweaked the performance to bring it into the faster segment of the market.

Installation Aid supplies a menu-driven program that helps the system administrator configure both the network and the individual workstations. According to the documentation, the program will help you to install applications programs, set up users, create shareable resources, and much more. One of the utility's key functions is to organize the server's fixed disk. Without it, we had to do all the tasks manually that the Aid would have handled. The installation process took a few hours, not unreasonable considering the complexity of the task. Installing the network program was easy. After loading DOS 3.1, we transferred the network program from the floppy disk to the hard disk. We next put the programs in a subdirectory (NETWORK) on the fixed disk. We then created subdirectories for all users and applications.

This process was the first part of the installation. Then came the fun part, configuring the system and creating all the necessary links. From the server, we invoked the network program and got into the network. At this point, we were at the main system menu, "task selection." From this menu we chose the disk or directory tasks menu. The menus that followed enabled us to designate shareable resources, set up volumes, and perform all other disk/directory activities. We set up a private directory for each user, besides creating the links necessary to share the \NETWORK subdirectory.

Configuring the network for printers was also easy. We simply chose "printing tasks" from the main menu and designated the server attached printer as "print1." Installation on the server was complete. We did spend a considerable amount of time setting up configurations for the various workstations.

The documentation for the installation procedure was based entirely on the Installation Aid. The documentation appeared to be very good, though we have no idea how closely it matches the actual program. An overall description of the hard disk organization would have been helpful. We hope IBM considers this in future (or at least production) releases of the program. The old standby about IBM documentation holds true for the network: All the information is there, but you have to wade through many pages to find it.

The ability to save your configuration from a menu option is interesting. This menu selection allows you to generate a list of the appropriate network commands without entering them manually. For example, the server must know which disks or printers the network can share. You generate this list from the command line, and it's very straightforward.

Once you've selected your options, you back out of the menus by hitting Esc once for each level of menu to the task selection

menu. Option 7 from this menu lets you save or cancel the network setup. If you choose to save the network setup, all the setup steps you selected are saved to disk as a command list. The commands are performed automatically at boot time. As long as you're not doing anything fancy, you can configure the network from the menus without consulting the manual.

Along with the network card, IBM ships a revised version of its diagnostics disk. This new release contains support for the network card and documentation for troubleshooting.

Documentation

Documentation supplied with the network program consists of a very complete manual in the now-familiar IBM format. Though the documentation is preliminary, it's well done and gives a good sense of what you will receive in the final package. The documentation is divided into useful categories. The most important section was "Guidelines for Sharing Disk, Directories, and Printers." We would like to have seen more concrete examples in the documentation, though IBM appears to have made a sincere effort to make the documentation readable and understandable by the nontechnical user. All in all, we were pleased with the level of documentation supplied.

Several useful appendixes discuss topics such as guidelines for application developers, general guidelines for the network environment, multi-user considerations, and coexistence of applications with the network program. These appendixes were concise and had valuable information for the advanced user and developer.

User Interface

IBM's user interface really shines. The system is a quantum leap in ease of use over any of the other networks we tested, with the possible exception of the 3Com system. The IBM program allows users

performing network tasks to work in either command line mode or menu mode. When the network program is started, you sign onto the system giving a network name to the PC you're working.

After you give the network name, the system presents you with the question, "Do you want to start the network?" If you reply yes, the system takes you to the

For user interface and ease of use, we think that the PC network sets a new standard. As for the IBM network's hardware, the system defines the state of the art.

main menu screen. From this menu, you can control resources, set up the machine, and, in general, do any network task that your mode will allow (remember all the stuff about the server, messenger, receiver, redirector). These menus are concise and understandable and include a context-sensitive help facility. They are also reminiscent of IBM's recent efforts in the mainframe world. We hope the company continues in this direction; it's very welcome.

The second mode of operation is the command mode. From any menu, pressing F2 gives you a command line at the bottom of the screen. You may enter any network command from this line. The commands seem to execute faster than they do from the menus (which is reasonable), though we didn't have a chance to confirm this impression. In any case,

experienced users or system administrators will probably use this command line once they are familiar with the commands. Most other users will opt for the menus, which effectively insulate them from puzzling through the commands.

The network has fewer than 20 commands, a reasonable number to deal with. The command language gives you a lot of control. With the help of the documentation, which is very good on commands, we could control the network either from the menus (our preferred method) or the command line. Thanks, IBM, for making this network easy to use.

Conclusion

What can we say about the IBM network? This product was created with intense anticipation. How does IBM's entry into this arena change the field? After using the network and putting it through its paces, we conclude: for user interface and ease of use, we think that PC network sets a new standard. In hardware, the system defines the state of the art.

The intelligence the board holds is truly phenomenal. The first five ISO layers are contained within the network adapter. For the future, the broadband implementation allows for expansion into video, voice, security, and so forth, all on the same cable.

The IBM network will force other network vendors to reduce their prices to compete or be blown away. We recommend the product, but bear in mind that we evaluated a prerelease version. We expect that the final version will hold its own against most products on the market.

IBM has once again brought us a reliable, conservative product. Other networks may perform better and offer additional features, but as an all-around network, the IBM PC Network will become a leader. Certainly none surpasses it in its ease of installation and its level of user interface. ■

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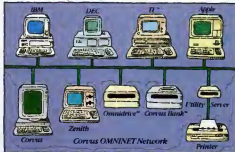
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Benchmarks For Network Ratings

Robert Cowart and Peter Feldmann

Someone once said that statistics often lie, and liars often use statistics. Whether the deception is intentional or unconscious is another question. Nevertheless, even computer users, who rely and often thrive on numbers, will sometimes distrust them. Yet the need to use numbers to objectively evaluate microcomputer networks is obvious.

When you decide which computer hardware or software to purchase, you compare features, including ergonomics and compatibility. You also consider the equally relevant, objective issue of speed because the value of computers is their ability to do work faster than people.

Though personal preference for one computer over another has its place, to reach objective, reliable comparisons, we're stuck with numbers to measure speed.

The numbers are benchmarks, and a set of testing procedures (or benchmark programs) is used to generate them.

CPU vs. Disk I/O

CPU performance, although always important, is most obvious when you perform mathematical calculations, such as recalculating a large spreadsheet, or run a program that is completely stored in RAM. Roughly speaking, performance in this area is a function of microprocessor clock speed, meaning that a machine with

a faster microprocessor than the IBM PC, such as the AT&T 6300 or Compaq Deskpro, will recalculate your spreadsheet faster than the PC.

As you might expect, though, a computer system's overall speed (often called throughput) is governed by its weakest link, not its strongest. This link to the real world is usually a disk drive. This "outside world" connection from a computer, the input/output (I/O), includes, among other things, the printer, keyboard, CRT, network cable, and modem.

Compared to the speed with which a microprocessor can move data, a floppy or hard disk drive is a sluggish behemoth, slow enough to leave the CPU twiddling its thumbs during periods of intensive disk activity. As a result, most computers are I/O bound, meaning that they can work only as fast as the physical devices attached to them work. Consequently, CPU speed is sometimes irrelevant to ultimate performance, and any thorough benchmarking procedure should be realistic enough to exercise all avenues of data flow through the system.

Benchmarks

Businesspeople, the bulk of potential network users, are usually more interested in prime rates than prime numbers. And if you believe the surveys and sales figures, most microcomputers run programs that fit into one of three areas: word processing, spreadsheets, or database managers. Consequently, using traditional benchmarks to evaluate computers is like choosing a stereo system by its power output instead of harmonic distortion curves. Benchmarks usually supply many numbers, but they only show a small part of the picture. In addition, the simpler the benchmark test (that is, the less it measures), the more accurate and, unfortunately, less meaningful it is.

For our strategy in testing networks in

Benchmark testing of local area networks calls for relevant, repeatable tests using popular applications performed in typical operating environments.



BENCHMARKS

this issue, we tried to create relevant and repeatable benchmarks, designed for the microcomputer network environment. We wanted to test the networks thoroughly but only in realistic operating environments—combinations of software and hardware that simulate everyday situations. Although PCs and computer networks are used in increasingly diverse applications, from tracking Olympic athletes to monitoring space shuttles, we decided on more mundane but common computer/network uses. For comparison in our local area network testing project we used a typical business office, a software engineering shop, and a transaction environment.

Because the average size of a LAN is about four PCs, we began with this structure to build each environment. This involved many hours of trial and error, because our tests had to be reliable, repeatable, realistic, and automatically executing (difficult with off-the-shelf software such as *Multiplan*, *dBASE II*, and *LAN:Datastore*). The tests also had to be self-timing because we didn't want to spend hours in front of PCs holding stopwatch; nor would that have been as accurate as self-timing.

Test Carriers

To duplicate the tests from one network to another and keep the framework of the tests from varying from one operator to the next, we designed a carrier program to hold the applications for the benchmark tests. This carrier was in the form of a standard DOS 2.x batch file, a list of separate commands usually called from DOS that would execute automatically from the top of the file to the bottom and then loop around again for the next iteration of the test.

We also wanted consistent timing for these tests and decided to put our computers to work to help us run timing as well as conduct the applications programs. With

some exceptions, it worked well and gave us a consistent set of times that we could use for comparison.

We designed the batch files to control

For our strategy in testing networks, we attempted to create both relevant and repeatable benchmarks.

execution of the benchmarks and save the results to another file, which could be analyzed later. We gave the file extension .LOG automatically to these files and wrote a simple program that read the .LOG files, totaled and averaged the results, and then wrote an output file, which we then used as the basis for our network benchmarking results database.

Because one of the principles of a scientific study is to control as many variables as possible, we had to be rather cautious in our methodology. Had we tried to test networks using real computer operators sitting at keyboards, we couldn't have duplicated exactly the timing of input to the networks from one test to another. Batch-testing files eliminated this source of variability.

We also had to avoid the temptation to fine-tune our batch files to meet the idiosyncrasies of some networks; where necessary, we adjusted the batch files outside the main timing loop to avoid upsetting the statistics.

Batch files, however, proved a mixed blessing because of their limitations. For example, our selection of application programs (word processors, database managers, and spreadsheets) was limited because we could only use programs that would accept input from a DOS text file, *ProKey* (a keyboard simulator), or the application's built-in keyboard macro (if it had one). We couldn't use *WordStar*, for

```
Notes: This file does sorts, indexes, copies, appends,
deletes, and packs a dBASE II database. Called and controlled
by the .BAT file below:

: *** DB.BAT - P. Feldmann 9/18/84 (805) 967-7837
: *** Files needed for this test:
1 DBASE program files - DBASE.COM DBASEOVR.COM DBASEMSG.TXT
1 Sorting prgm and file to be sorted - SORTDB.DBF SORTTEST.PRG
1 This file - DBASETEST.BAT tone.com
1 Input files - NTR.TST - for C/R @TIME.TST - to zero time
1 A screen control utility - ESC.COM (not really needed, but nice!)

ECHO OFF
CLS
ESC [5;24H
pause
tone
:TOP
tone
tone
tone
cls
echo DBASE II testing is starting over again, folks!
ESC 7;15H
: *** Set time to 0 to start test - redirect to nul file
TIME ( @TIME.TST ) NUL
DBASE dbob
TIME ( NTR.TST ) > X1.LOG
GOTO TOP
```

(continues)

Figure 1: dBASE II disk-intensive program.

[illegible]

example, because once we entered *WordStar*, we couldn't exit and return control to the batch file for the next iteration.

Firing Order

Once we wrote the programs, we had to choose on which of the four PCs in a network to run each benchmark test and when. For example, should we start with just one, then progress to two, three, and four PCs running simultaneously? If we used a mixture of programs, how should we assign them? Assigning programs is important since the server typically will run its applications slower because of its additional network I/O handling responsibilities. Should we measure the time penalty for running a particular test on the server compared to running the same test on a workstation? With the help of Ziff-Davis's Belmont Labs, Bob Buchanan of 3Com Corporation, and Bob Hooper, an independent consultant, we finally arrived at the methodology that follows.

Productivity Environment

The most common use of networks is in a multi-PC office where the PC's tasks include word processing, spreadsheet manipulation, and data processing. Word processing will probably be more popular, so we assigned that task to two workstations. We assigned database manipulation and spreadsheet work to the other two. We designed the productivity environment to simulate four workers' average use of this network.

- User 1, working with a database, calls up *dBASE II*, loads a 100-record, name-and-address file, sorts the file to another disk file, appends several records, deletes them, creates an index, and then exits back to DOS, storing the elapsed time to disk. Several 30-second delays thrown into the program simulate the thinking time, telephone answering, and so forth that will often occur in an office setting. Figure 1

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shows the program listing.

● Users 2 and 3 on each network run a program (actually written in *dBASE II*) that simulates a typist's duties, by typing lines of characters to the screen, pausing, going to the bottom of a file, then opening and writing some information to a file and closing it again. We intentionally kept the disk I/O light, as in any word processing environment. We could not use *WordStar* because of the problem discussed earlier.

Figure 2 shows the listing.

● User 4 is a spreadsheet operator who calls up *Multipian* and then loads a relatively small file. All keystrokes are executed automatically using *ProKey*. Next, the matrix is enlarged to 30x30, and a recalculation is performed. All formulas are relatively simple, using the primary mathematical functions. Finally, the file is saved under a new name, closed and deleted, and the elapsed time is recorded in a disk file. Figure 3 shows the listing.

Development Environment

Although heavy-duty programming is normally done on a mainframe or dedicated development system, the demand for programs to run on the IBM PC and compatibles leads to increasing use of PCs as programming development stations. We designed the development environment test to make very heavy use of the user station's CPU and server disk I/O (and, consequently, the network's data path).

Because of the amount of disk access needed to perform the assemblies and compilations, the server's hard disk rarely got a breather. Probably no realistic network demands so much of its resources as this program does; we fully expected to run into problems in using this test file, and we did. Several networks passed this test, however, and some did very well indeed.

Those of you who are familiar with the subtler details of programming should find

```

@ 13,12 say "***           Delaying for 30 seconds           ***"
store x+5 to x
store x-1 to x
store x-1 to x
store x-1 to x
store x-1 to x

@ 13,15 say " "
loop
enddo

@ 13,12 say " "
@ 14,12 say " "
@ 12,12 say " "

use dealers
* this one creates an index on a 20 character field.
use dealers
@ 18,20 say "Indexing on firm (20 chr field)"
index on firm to dlrfrm
use

* delay...
store @ to x
@ 12,12 say "*****"
@ 14,12 say "*****"
do while x(115)
@ 13,12 say "***           Delaying for 30 seconds           ***"
store x+5 to x
store x-1 to x
store x-1 to x
store x-1 to x
store x-1 to x
@ 13,15 say " "
loop
enddo

@ 13,12 say " "
@ 14,12 say " "
@ 12,12 say " "

use dealers
* creates another index which will be used for appending
use dealers
@ 19,20 say "Indexing on year (2 chr field)"
index on year to dlyryear
use

* delay...
store @ to x
@ 12,12 say "*****"
@ 14,12 say "*****"
do while x(115)
@ 13,12 say "***           Delaying for 30 seconds           ***"
store x+5 to x
store x-1 to x
store x-1 to x
store x-1 to x
store x-1 to x
@ 13,15 say " "
loop
enddo

@ 13,12 say " "
@ 14,12 say " "
@ 12,12 say " "

use dealers
* now just copy a file to see how long it takes.

```

(Figure 1 continues)

```
use dealers
@ 20,20 say "Copying the dealer file to Temp.dbf"
copy to temp
use

e delay...
store @ to x
@ 12,12 say "*****"
@ 14,12 say "*****"
do while x(115)
    @ 13,12 say "***          Delaying for 30 seconds          ***"
    store x+5 to x
    store x-1 to x
    store x-1 to x
    store x-1 to x
    store x-1 to x
@ 13,15 say "      "
loop
enddo
@ 13,12 say "      "
@ 14,12 say "      "
@ 12,12 say "      "

use dealers
@ 21,20 say "Setting 2 indexes on snd appending a record."
set index to dirfirm, dlyear
append blank
replace firm with "Harris"
replace year with 81
use

e delay...
store @ to x
@ 12,12 say "*****"
@ 14,12 say "*****"
do while x(115)
    @ 13,12 say "***          Delaying for 30 seconds          ***"
    store x+5 to x
    store x-1 to x
    store x-1 to x
    store x-1 to x
    store x-1 to x
@ 13,15 say "      "
loop
enddo
@ 13,12 say "      "
@ 14,12 say "      "
@ 12,12 say "      "

use dealers
@ 22,20 say "deleting one record... and packing"
goto bott
delete
pack
? chr(7)
? chr(7)
? chr(7)
? chr(7)
? chr(7)
? chr(7)
? chr(7)
? chr(7)
erase
quit
```

the following list of 13 steps that the batch file executed enlightening. (We used IBM's Macro Assembler and BASIC Compiler.) The program in Figure 4 assembles both sample files on the MASM disk, links them, deletes the .OBJ files, runs the program, deletes the program, compiles a version of *PC-TALK III*, links

PC-TALK III; deletes both the .OBJ and .EXE file, assembles a file dumping program, links it; runs the program (dumping itself to the screen); deletes it; gets the elapsed time; and loops back to the beginning.

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BENCHMARKS

results from elsewhere in this section.

To measure this degradation, we ran the development environment batch file four times; first, on the server alone, then on one workstation alone. The difference between these two figures indicates the degradation that the network imposes.

Next, we ran the test on both of the two workstations simultaneously and, finally, on four workstations simultaneously. In most cases, we skipped the three-station test because we were able to extrapolate the curve of degradation fairly well using the other figures. On some networks, the program wouldn't execute on four stations; so, where noted, we used three instead.

Transaction Environment

Letting a network's multiple users enter, edit, and otherwise manipulate records in a single large database is a useful though difficult goal in networking. Multiple use of a single database is possible only if you keep intact the integrity of the database as a whole by flagging or identifying each individual record in the file as an entity.

You also must restrict access to records to one user at a time. If you simply try sharing and editing a database using a program designed for a single user, such as *dBASE II*, you're inviting catastrophe.

Unfortunately, few programs currently sport true multi-user capability. One reason for this is the lack of standards for implementing the necessary record-locking scheme, which is required in order to avoid the inevitable collisions that would occur when two people try to use the same file. And because each network operating system works a bit differently, a manufacturer's development cost and time for rewriting a program to run on all the networks can be prohibitive.

Another problem is that most of the popular database programs weren't de-

* DBASE programs for testing

This first one is called *dbsec.prg* and emulates some light typing to screen and saving to disk, similar to a word processor. It is called by the batch file just before it.

```

: *** DBSEC.BAT - COMART 9/10/84
: *** Files needed for this test:
: DBASE program files - DBASE.COM DBASEDVR.COM DBASEMSG.TXT
: DBSEC.BAT, tone.com
: Input files - NTR.TST - for C/R @TIME.TST - to zero time
ECHO OFF
CLS
pause
!TOP
cls
echo Typist Emulator is starting over again, folks!
: == Set time to 0 to start test - redirect to nul file
TIME ( @TIME.TST ) NUL
DBASE dbsec
TIME ( NTR.TST ) > %1.LOG
GOTO TOP

```

* This is the *dBase II* file used. Note just one field, but lots of text (50 characters) to fill up the screen, and take up about the same disk space as 100 lines of text in a text file.

```

STRUCTURE FOR FILE: A:\TYP1ST .DBF
NUMBER OF RECORDS: 00099
DATE OF LAST UPDATE: 09/15/84
PRIMARY USE DATABASE
FLD NAME TYPE WIDTH DEC
001 INFO C 050
** TOTAL ** 00051

```

```

* file DBSEC.PRG
* Typist emulator for benchmarking pc nets for pc mag.
* robert comart 09-14-84
set talk off
? "Opening the file called typist.dbf"
use typist
grass
? "*****"
? "Light-duty FILE OPENING AND CLOSING PROGRAM - WORD PROCESSOR EMULATION"
? "Another net-crusher by d808. Inspired by Peter Feldman"
? "*****"
? "A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 1 2 3 4 5 6 7 "
?
*delay
?
? "DELAYING....."
store 0 to x
do while x<100
store x+1 to x
enddo
? "1 2 3 4 5 6 7 8 9 0 ! @ # $ % ^ & * ( ) _ + - = , . ; "
?
? "d f j g h j k l q w e r t y u i o p [ ] \ / , . ; "
?
*delay
?
? "DELAYING....."
store 0 to x
do while x<100
store x+1 to x
enddo

```

Figure 2: Word processing simulation program.

```
? "Just printing things to the screen as might occur during"
? "the use of a word processing package. This method was used"
? "because we needed to automate the benchmarking process, and"
? "word-processors don't usually allow this type of automation"
? "from the command line."
```

```
*delay
?
? "DELAYING....."
store @ to x
do while x<100
store x+1 to x
enddo
```

```
?
?
? "displaying next 15 records..."
display next 15
```

```
*delay
?
? "DELAYING....."
store @ to x
do while x<100
store x+1 to x
enddo
```

```
? "Changing several lines in the file..."
? "Going to bottom of file..."
goto bottm
? "Sent to bottom of file"
? "Replacing last record with new text..."
*
```

```
REPLACE info WITH "now for a modification of a line of text..."
? "Going to record # 50..."
```

```
50
? "Going to bottom of file..."
goto bottm
*delay
```

```
?
? "DELAYING....."
store @ to x
do while x<100
store x+1 to x
enddo
```

```
?
? "Going to top of file..."
goto top
```

```
*delay
? "DELAYING A LONG TIME ....."
store @ to x
do while x<1000
store x+1 to x
enddo
```

```
?
? "GOING TO THE BOTTOM OF THE FILE NOW..."
goto bott
```

```
? "Now closing the file, and exiting to network operating system."
* Ring the bell several times to announce end of test...
```

```
? chr(7)
? chr(7)
? chr(7)
? chr(7)
```

```
? "=====
? "=====
? "=====
? "=====
? "=====
? "=====
quit
```

(Figure 2 ends)

signed for a multi-user environment, and adding this feature as an afterthought is difficult. It's usually easier to start from scratch. For example, Ashton-Tate's *dBASE II Multi-User*, after months of work, is available as of this writing only for the 3Com network. (A version for the Novell NetWare network operating system is in the works.)

For our testing, of course, we needed a database program that at least claimed to run on all our networks. This narrowed the choices considerably, and the only one that was shipped to PC in time for testing was *LAN:Datastore* by Software Connections. So we used it but not without rather substantial difficulties.

LAN:Datastore supplies adequate record-locking when multiple PCs use it, but at a price: Its main program occupies more than 225K, not counting an overlay message file (without which it won't run) of 100K. This means a total of 325K bytes before you call up a data file to work on. The database files themselves aren't lightweights, requiring close to 60K to store a file of 100 names and street addresses, each 60 bytes long, for a data control overhead of about 900 percent.

An obvious corollary of this tremendous program and data file size is slow execution speed, and *LAN:Datastore* met our expectations in this regard as well, taking almost 1½ seconds per record to copy a file from one database to another. But it worked fairly reliably on most of the systems.

We thought it imperative to test the networks in a transactional multi-user environment; so we gritted our teeth, filled each user station with 640K of RAM, and set to work. The benchmark file we came up with was fairly simple, though getting there was quite a challenge. For reasons still unknown, *ProKey* wouldn't control *LAN:Datastore* properly and caused a variety of errors. When we called Soft-

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were Connections, we were informed of an undocumented feature of the program that allows auto-execution of keystroke files.

In its final form, the transaction environment test uses three levels of control: A batch file invokes *ProKey*; *ProKey* loads *LAN:Datastore* and its key file, which then takes over. The file subsequently loads a database of names and addresses, adds three new records, sorts the file, deletes three records, displays some vital statistics about the database, and exits. We ran the test in identical configurations to the development environment tests (single user, two users, and four users), but in this case, all stations competed for access to the same database concurrently rather than using private read/write files in separate subdirectories. Figure 5 shows the listing.

Observations and Conclusions

Despite the many grueling hours we spent in the development, execution, and tabulation of our results, there were times when even our best efforts were thwarted. Some of the networks simply wouldn't cooperate with our procedures, although all of our tests ran flawlessly on standalone PCs and XT's as well as on the majority of the networks.

Sometimes a phone call to the network manufacturer's technical support group cleared up the problem.

Our first serious problem occurred during the development stages of our batch files, when the Fox 10-Net refused to run batch files correctly by failing to find existing programs and files on the server's hard disk and by occasionally hopping over command lines. We found no solution for this error.

Another abnormality surfaced when the Corvus network ran the server's internal clock backward. This obviously confused our batch file timing procedures, but add-

```
.this is a test batch file for multiplan
*
break on
pload
prokey ap-pro/r
prokey/f-
.this should slow up the typing
time( tf
start
prokey [f9]
ap
time( t )) %I.log
goto start

THE PROKEY FILE...

(begdef) (f9)
(cwd) d3.0 (enter) f (cwd) d2.0 (enter) d (enter)
(tab) % (enter) (cwd) d2.0 (enter)
v1000 (enter) (cwd) d2.0 (enter)
(dn) v1c1 / (row) * (column) (enter)
cd30 (enter) (cwd) d2.0 (enter)
cr (tab) r:35c1 (enter)
t (cwd) d2.0 (enter) edummy (enter)
yq (cwd) d2.0 (enter) y (enddef)
*
```

Figure 3: Multiplan testing using ProKey and a batch file.

```

Program Development Environment
-----
Source listing for the development environment written by Bob Hoopers

TIME( tf
:START
mass EXPMIN;
mass EXPMIN;
link EXPMIN EXPMIN;
del EXPMIN.OBJ
EXPMIN EXINFIL
del exmpln.exe
BATCH PCT /E
LINK PCT;
DEL PCT.OBJ
DEL PCT.EXE
mass DUMP;
link DUMP;
DUMP DUMP.EXE
del DUMP.exe
TIME( t )) %I.LOG
TIME t
GOTO START
```

Figure 4: Program development environment.

ing an AST hardware clock board in the server PC eventually set things straight.

The TeleVideo network threw a wrench into the works when it simply refused to run *dBASE II*, of all programs. (You would think this program, because of its popularity, had been thoroughly tested by the company.) This development put

a damper on our productivity environment testing until a TeleVideo representative arrived with a modification to both *dBASE II* and the TeleVideo operating system (a version of Novell's NetWare). Apparently the company has documented the necessary changes (though we didn't see them) so that the user can make the proper

Transaction Environment Testing Procedure

```

This is the batch file
echo off
cls
ECHO ===Output will be written to: %1.LOG
IF EXIST %1.LOG GOTO SCRATCH
echo .
echo .
echo .
ECHO ===== LNTST2.BAT =====
ECHO Feldmann, Hooper & Cowart - 9/20/84
ECHO This file will bring up LAN:DATASTORE
ECHO and run it automatically using PROKEY and
ECHO LAN:DataStore's auto key file.
ECHO A time sequence will then be called to write
ECHO the elapsed time to the specified file with
ECHO an extension of .LOG
echo .
echo .
echo .
ECHO ** uses lantest2.key Prokey file **
ECHO ** uses lantest.kkl lan datastore key file **
echo .
echo .
ECHO DON'T HIT RETURN WHEN LAN:DATASTORE asks you to!!
PKLOAD
PROKEY lantest2.key/R/F=
ECHO **** PROKEY NOW READY FOR TEST! ****
ECHO PRESS ANY KEY WHEN READY TO BEGIN, THEN :
ECHO TYPE ALT-F9 FOR EACH ITERATION YOU WISH TO RUN NOW. .
ECHO * * * * * (ie. typing alt-f9 three times will run 3 iterations.)
pause
ECHO ----- Actual test starts here.
:TOP
CLS
ECHO * * * * * NOW AT BEGINNING OF BATCH FILE * * * * *
ECHO .
ECHO zero time here
TIME ( @NTR.TST )
ECHO .
ECHO invoke datastore (Prokey will add input to program)
prokey %altf9%
ECHO .
ECHO display results to screen (can be deleted if desired)
ECHO TYPE REPORT - eliminates - errors created by several
ECHO users creating reports with the same name.
ECHO get elapsed time here and write to filename.LOG
TIME ( @NTR.TST ) %1.LOG
ECHO display results on screen (could be to printer ??)
ECHO ===== Here are test results so far:
ECHO TYPE %1.LOG
ECHO get rid of extra disk file
ECHO eliminated ** this line too. see above DEL REPORT
ECHO .
ECHO * * * * * NOW GOING BACK TO TOP OF TEST FILE * * * * *

: loop to top of test
GOTO TOP
EXIT
ECHO EXITING FILE . . . . .
EXIT

```

adjustments himself.

In addition, LAN:DataStore simply won't run on any of the XT servers under Novell's NetWare. We encountered no problems on the three workstations, however.

Another problem worth noting, and a challenge when testing speed performance of networks, is the occasional appearance of the familiar message:

Error reading drive C:
Abort, Retry, or Ignore?

At first, we were concerned that this message indicated a true read/write error to the server's hard disk. But we discovered that the message appeared only during heavy disk activity; at other times, the disk seemed fine. After considerable thought and consultation with manufacturers, we found that just as when you run normal DOS, if your computer must wait too long to communicate with a disk drive, this message pops up. It's simply a "time-out" problem.

In our networks, sometimes the server's disk and the network data path (cable) are so busy that one of the stations takes a time-out while waiting for data from the disk. We decided that this is normal, and inclusion of the retry is a legitimate part of the benchmark test.

If you're considering the purchase of a PC network, look over our findings carefully, considering the type of programs you intend to run. Keep in mind that while trying to simulate typical applications environments, we intentionally put the networks under an unreasonable amount of stress.

You can usually expect greater reliability and speed than we experienced, but beware—networking technology is a quickly evolving field. Prepare yourself for more and different problems than when you use your PC as an independent workstation.

Figure 5: Transaction environment testing procedure.

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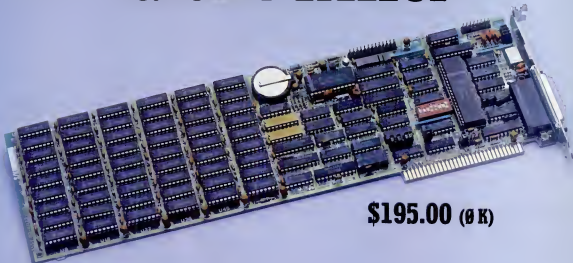
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LAN Speed Trials

John Dickinson

Finding the right local area network for your environment and applications can be a complex task.

When you are sorting through all the products there are to choose from (and more are on the way), you have to consider network performance and overall cost as key factors. *PC's LANmarks* should help you find your way.

LAN pricing tends to be complex, but a general rule is that actual LAN costs depend on the number of workstations you'll start with and how many you plan to

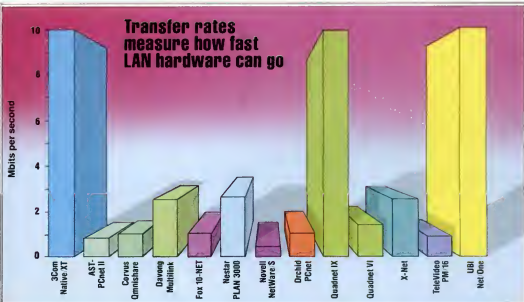
attach in the future. The per-station cost of a LAN will go down as you add workstations, so a four-station network that seems relatively expensive may be more cost-effective if you plan to add to it in the future. You can compare LAN costs using *PC's* graph of per-station cost for each network when it is configured with from 3 to 20 stations.

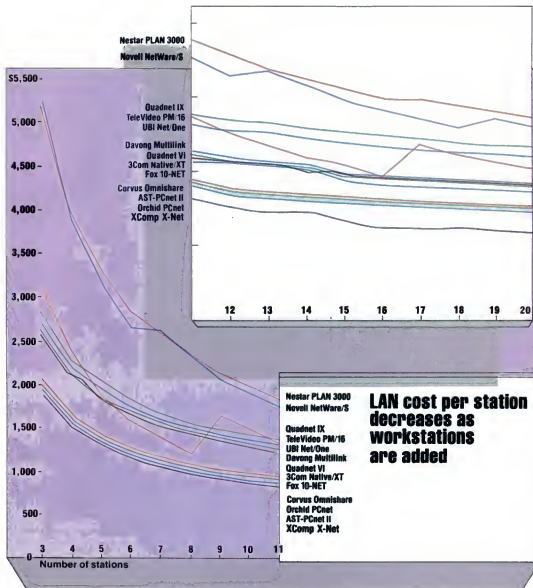
Raw LAN transfer rates (megabits per second transferred over network lines) show the potential performance available from each network's hardware. A bar

How Do the Networks Stack Up Against a PC?

You might be wondering what all the benchmark numbers really mean to you. One way to use these findings is to compare the LAN figures to the performance of a standard PC-XT doing the same jobs. These figures show how the benchmark programs run on a 512K PC-XT using PC-DOS 2.0.

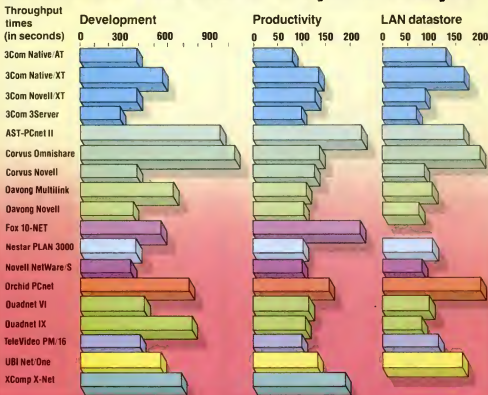
Task	Time
Development	62 Seconds
Productivity	91 Seconds
LAN: Datasore	208 Seconds





BENCHMARKS

The bottom line is the amount of work you can actually do



graph lets you compare the transfer rates for each local area network that *PC Magazine* tested.

Transfer rates are the most readily available LAN performance number; the bottom line on performance, however, is the amount of work you can push through each attached PC. The throughput bar charts show you how many seconds each network PC tested took to perform each of

the tasks (development, productivity, and LAN: Datastore) described in the benchmark methodology article (see "Benchmarks for Network Ratings"). In some cases the network tests were run with alternate hardware configurations or with Novell's NetWare operating system, and these times are shown on the chart. The standalone PC times show you how fast the same applications can be expected to

run on a standard PC-XT.

Performance and cost statistics can help you find your way, but some important items just can't be measured with numbers. To find out how easy a network is to set up and use or how well it protects your files and applications, you can resort to words by reading the reviews to see how well each network stood up to our authors' scrutiny. ■

"We decided waiting another decade for the standard in business software was too long."

Instead, Macola, Inc. has taken the Standard in Business Applications Software for *minicomputers*, from MCBA,[®] converted it to R/M COBOL for 16-bit computers, and created, we believe, the *Micro-Standard*.

Hundreds of microcomputer business applications packages from scores of programmers were rushed to market during the last ten years as the microcomputer became an everyday business tool.

Many were fine packages—filling niches, stop-gapping problems, allowing the businessperson to *maintain*—probably not drop behind, but definitely not surge ahead.

What was missing from these packages varied from package-to-package. Some lacked power. Some, simplicity. Others, clarity. Most lacked real integration.

Introducing Some Old Software

During those ten years, Mini-Computer Business Applications, Inc. (MCBA), was quietly establishing the standard for Business Applications Software for minicomputers.

Today, much of the new software developed by other companies boasts compatibility with MCBA's packages.

Macola, Inc., finding the current micro-packages unacceptable against the standards they sought, and realizing the time

involved in developing their own set of packages, approached MCBA, obtained the rights to convert the powerful minicomputer software, then did just that.

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














































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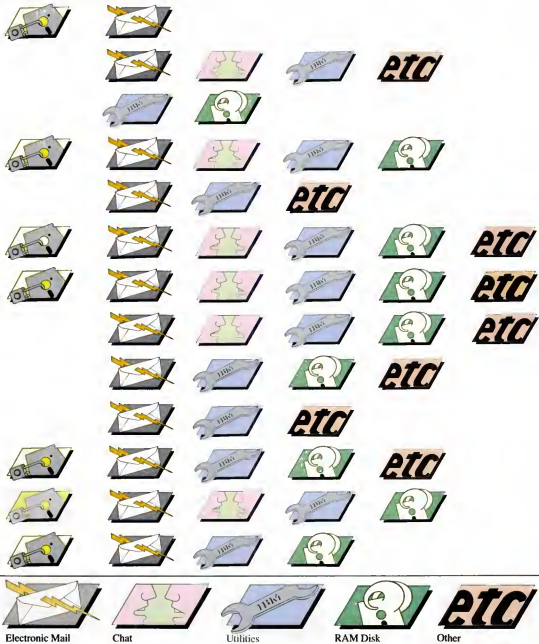
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NETWORK HIGHLIGHTS AT A GLANCE

	Architecture	Security		
3Com EtherSeries				
Fox 10-NET				
AST-PCnet II				
Corvus Omnishare				
Davong Multlink				
Nestar PLAN 3000				
Novell NetWare/S				
Orchid PCnet				
Quadnet VI				
Quadnet IX				
TeleVideo PM/16				
UBI Net/One				
XCOMP X-Net				
				
Ring/Bus/Star	Login ID	File Passwords	File Protection	Record Protection

Applications



Electronic Mail

Chat

Utilities

RAM Disk

Other

NETWORK HIGHLIGHTS AT A GLANCE

Shared Peripherals Available

3Com EtherSeries



Fox 10-NET



AST-PCnet II



Corvus Omnishare



Davong Multilink



Nestar PLAN 3000



Novell NetWare/S



Orchid PCnet



Quadnet VI



Quadnet IX



TeleVideo PM/16



UBI Net/One



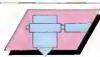
XCOMP X-Net



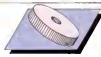
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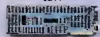
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Graphics resolution on IBM mono 720 x 348	✓		✓	✓	
Plantronics color graphics compatible	✓			✓	✓
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CIRCLE 384 ON READER SERVICE CARD

Battle of the work stars

The Editors of PC

he best way to see if a network has the right stuff is to run it through its paces. So here are the objective facts and reviewer opinions compiled during extensive flight testing of 13 networks.

To help place the specifics in context, we've also included discussions of pertinent network issues.

Networks are not yet standardized, but enough permutations of hardware and software exist to suit a wide range of office environments and business needs.



3Com EtherSeries

Though not the most comprehensive network around, this LAN from 3Com should bring many PC users together in happy harmony.

For PC users completely comfortable with PC-DOS, the 3Com EtherSeries network can't be beat. It allows them to share printers and hard disks, communicate among themselves, and basically improve their use of PCs at a single location. However, in an environment that requires security and sophisticated file-sharing techniques, the 3Com network leaves something to be desired.

EtherSeries is actually a set of four products from the 3Com Corporation. EtherLink, the PC card, plugs into an IBM PC or compatible and performs the communication task. *EtherShare*, the software, allows PCs with EtherLink cards to share hard disks, printers, and other network resources. EtherPrint, 3Com's print handler, allows all network users to share up to two printers attached to each server. And there's an optional electronic mail program, *EtherMail*.

According to 3Com, the EtherSeries establishes a networking environment that meticulously adheres to the proposed IEEE 802 standard for a CSMA/CD baseband network. One of 3Com's publicly stated goals for the product line is strict observance of established standards, and this led the company to adopt the widely

supported Ethernet implementations.

3Com carried this same thinking into the design of the *EtherShare* network server software. The only departures from the standard PC-DOS user interface are the commands and utilities necessary to support multiple users in a networked environment.

Hardware Interaction

The configuration reviewed here uses a PC-XT as the network server with three PCs as workstations. You can operate the PC-XT in either dedicated or standard mode. You cannot use a dedicated file server as a workstation to run applications in its own right; it functions only to service the other workstations on the network. The standard (or nondedicated) mode allows you to use the file server as an additional workstation on the network. In standard mode, the PC-XT user has complete access to network printers, network volumes, and all other shared resources, although the server/workstation cannot link to drives on other servers in the network.

If you wish to, you can also use the server as a regular PC without logging onto the network, but you will not have access to network disk volumes, network printers, or other shared devices. In this

mode, you can read from nonnetwork volumes on the hard disk, but you cannot write to them, because the server task is running in the background. You can read and write to floppy disk, but the *EtherShare* documentation warns that floppy disk activity on the server will lower the performance of the network. In general, users of the server/workstation will want to be logged into the network for full access to all network resources.

The server must be in dedicated mode to perform certain network maintenance tasks, such as installing and configuring printers, and to support *EtherMail* and multiple fixed disk drives. (A 3Com representative indicated that a forthcoming update would allow the server to support *EtherMail* and multiple drives in the standard mode.) The dedicated server mode also monitors network traffic and disk activity.

RAM: Free for the Tasking

The server function requires a minimum of 256K RAM. The documentation is not specific, but it appears that *EtherShare* does not recognize or make use of any additional server memory, although a section in the appendix recommends experimenting with the DOS buffers for both servers and workstations to improve performance. Since running the server task left us with 384K still free, we had no trouble running our standard set of applications, which included *WordStar*, *1-2-3*, and *Framework*.

Unlike those in other Ethernet implementations, 3Com's board has its own transceiver, the device that takes digital output and converts it to analog signals for transmission over the cable. This unique feature allows a direct connection to standard 50-ohm coaxial cable (which 3Com refers to as thin Ethernet cable). The built-in transceiver and the use of relatively inexpensive coaxial cable and connectors

bring the price of an EtherSeries network in line with PC-compatible network offerings from other vendors.

Standard Ethernet, as implemented by DEC, Intel, and Xerox, requires an external transceiver, transceiver cable, and

thick standard Ethernet cable. Standard Ethernet allows a maximum of 1,000 nodes and 2.8 km of cable between the most remote stations in the network. 3Com's on-board transceiver and thin Ethernet cable will support up to 100 sta-

tions and a cable segment length of up to 1,000 feet. Using repeaters, which boost the electrical signal, you can use any combination of thin Ethernet segments and thick Ethernet segments needed to reach the desired configuration.

DEC, Intel, and Xerox support multiple servers on their Ethernet, and so does 3Com. 3Com currently allows for three different server types: the PC-XT as a low-end server supporting two to eight users, the 3Com AP (modeled on the ALTOS 586, a 10-MHz 8086-based machine) as an intermediate dedicated server for more power, and a VAX 11/750 for high-end applications. Any combination of these three servers can function on the same network.

A very attractive feature of the 3Com network is that it allows you to share virtually any vendor's mass-storage subsystem (such as hard disk, tape, or video) that is compatible with DOS 2.0 or a later version. So if you don't have a PC-XT but do have a PC with a hard disk drive or a tape drive from one of the aftermarket vendors (such as Mountain, Amcodyne, National Memory Systems, or Tecmar), you may already be set for a network.

Software Ups and Downs

EtherShare lets you divide the shared hard disk into volumes of any size from 64K bytes to 32 megabytes. The number of volumes you can create depends on the number of users and the size of the fixed disk. Each workstation on the network can access up to four *EtherShare* volumes which function like the disk drives on your PC. After going in, you link them to drive specifiers. If you have a PC with two floppies, your local drives will be A: and B:, and you can link drives C:, D:, E:, and F: to *EtherShare* volumes. If you also have a local hard disk, it will be drive C:, and your *EtherShare* volumes will be D:, E:, F:, and G:.

(continued)

LAN FACT FILE: ETHERSERIES

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(415) 961-9602

Retail Prices

Starter Kit	\$ 1,835
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Server Station	N/A
Dedicated Server	\$ 1,045
Cable (per foot)	\$ 1
Connector	N/A
Repeater	N/A
Four-Station Configuration	\$ 7,530

Hardware Capabilities

Configurations:

No. Servers	1-20
No. Workstations	2-1,024
Server Type	XT

Memory Min./Max.

Dedicated Server	N/A
XT Server	256/640K
Workstation	256/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input type="checkbox"/>
Type	<input type="checkbox"/>
Global?	<input type="checkbox"/>

Network Description

Architecture	Bus
Type	Baseband
Speed	10 Mbit/sec.
Server Type	XT

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input type="checkbox"/>
Others	<input type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input type="checkbox"/>
Utilities	<input type="checkbox"/>
RAMdisk	<input type="checkbox"/>
Other	<input type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

NETWORK SURVEY

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
3Com Native/AT	392	81	128
3Com Native/XT	563	128	166
3Com Novell/XT	391	123	89
3Com 3Server	285	98	73

The EtherPrint package supports printer sharing. Etherprint for the PC-XT will support two parallel printers connected to each server in the system. A 3Com representative indicated that a forthcoming update will also support serial printers.

Users gain access to the printers through a procedure analogous to the link procedure for accessing *EtherShare* volumes. Users may specify at link time which printer they wish to use. Then they can control printing through standard DOS or application print commands. Print files are automatically spooled to the hard disk and then printed on a first-come, first-served basis.

With *EtherShare*, any user on the system can create a volume, within the limits of available hard disk space. Whoever creates a volume also owns it. Any user on the system can also delete or modify volumes they own, or connect new users to the network. In this, the EtherSeries network differs significantly from the great majority of networks reviewed. Most networks reserve system-level functions for a "system manager," who oversees the allocation of network resources, sets up network security, and performs necessary system-level functions, such as backup/restore, adding new resources, and arbitrating disputes.

3Com has chosen a very simplistic approach to the issues of network access and security, which may prove inadequate in installations where these are areas of real concern. Access to *EtherShare* volumes is controlled by volume type and password. Using *EtherShare*, you can cre-

ate three types of volumes: public, private, or shared. You may assign a password to any volume at the time you create it, and anyone else wishing to use the volume must then supply the password to gain access to it. A public volume with no password is accessible in read-only mode to all users on the network. A private volume

The EtherMail Message Editor is really more like a full-featured text editor.

with no password can be used only by its owners.

Only one user at a time can use a private volume controlled by a password. Shared volumes may be accessed concurrently in read and write mode by all users who know the password. For this reason, shared volumes should only be used with applications that employ a semaphoring, or locking, file-sharing scheme. Semaphoring is a method of signaling with flags to coordinate access to a volume so that data are changed in an orderly way without risk of damage or loss. (See sidebar, "3Com 3Server.")

Unfortunately, *EtherShare* assumes that all applications and users on a shared volume will be well behaved. Apart from password control, there are no built-in pro-

tections against ill-mannered applications or user errors. The kind of situation in the following example could occur in any EtherSeries network.

Suppose a volume has been created to contain an inventory database using the popular database manager *dBASE II*. Since multiple users need access to this volume, it has been designated as a shared volume, and several users hold the password. Ashton-Tate's multi-user version of *dBASE II* is specifically designed to run on the 3Com network and uses semaphores properly to coordinate file access and preserve the integrity of the file.

How can a problem occur? Well, users on the system also have single-user copies of *dBASE II* that they typically use in creating and maintaining their own private database files. One of the users with access to the shared volume loads single-user *dBASE II* by mistake and uses this program to update the shared database. This results in disaster. Single-user *dBASE II* does not look for or care about semaphores and knows nothing about the need to inform other users that modifications are taking place. At this point, the data becomes hopelessly jumbled, since synchronization has been lost.

Most other network vendors provide safeguards to prevent this type of occurrence. These measures may include requiring permissions for individual file access or restricting user rights to files and volumes.

You have the option of adding *EtherMail* to the 3Com network. This full-featured mail system requires a dedicated server and 192K RAM (rather than the normal 128K) for each separate workstation. Along with many other capabilities, it can create distribution lists; attach up to 26 files of any size; reply to, forward, or print a message; and save a message in progress if you happen to be interrupted while composing it.

The *EtherMail* Message Editor is really more like a full-featured text editor, with features like automatic wordwrap and block-move capability. In fact, 3Com

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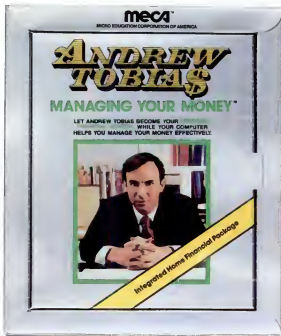
PERSONAL SOFTWARE MAGAZINE, JULY 1984

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CIRCLE 151 ON READER SERVICE CARD

NETWORK SURVEY

allows you to use the message editor as a standalone text-editing program that you can access directly from DOS.

Solid Performance

With the EtherSeries and most other networks we tested, a marked overall increase in efficiency resulted from using the PC-XT server in dedicated mode. In this mode the server's microprocessor is no longer burdened with the details of running local applications, allowing it to focus exclusively on network activities and increase its overall throughput. Usually, the trade-off between a dedicated and nondedicated file server is one of performance versus cost. A dedicated server improves the efficiency of the network, but having the PC-XT do double duty as both server and workstation adds another node to your network at no additional cost.

However, both the 3Com manual and a company representative claim that you can obtain the best performance on the EtherSeries by operating the server in standard (nondedicated) mode if the server will not be in continuous use as a workstation. This unusual circumstance has occurred because 3Com designed the dedicated mode first. By the time it got around to developing the standard mode, the company's expertise had increased. Letting your nondedicated server twiddle its thumbs while in an application program is another matter, though. For example, when your PC-XT server idles with WordStar running, more of the microprocessor's time is required than you might think, since WordStar uses a series of "polling" routines to continually check the status of the keyboard and the screen display.

3Com has estimated that a single-server system would provide acceptable performance for up to three users engaged in software development, six to seven users working on a multi-user database, and fifteen users in a productivity environment (running single-user DOS applications). 3Com suggests that if the network uses a 3Com AP server, the number of users can

be doubled. And the new High Performance server that 3Com expects to release sometime early in 1985 will triple the number of possible users.

In terms of performance, our benchmark tests place the 3Com network near the middle of the pack. However, the network seems to operate quickly. Closer examination of the test results indicates that when network activity is relatively light (as in a transaction environment), performance is good. In a typical office environment, 3Com's EtherSeries should prove a more-than-adequate performer.

Easy Installation

Installing the EtherLink hardware is a breeze. The documentation is clear and well illustrated, and if you are using the

built-in transceiver and thin Ethernet cable, you don't have to set any switches on the board. Each EtherLink card is fitted with a BNC "T" connector, and the thin Ethernet cable comes with mating connectors. BNC connectors resemble common CATV connectors, but they mate with a twist-and-lock motion instead of screwing in; they are actually simpler to use.

If your PCs have lots of extra features (such as communication cards or extra serial and parallel ports), you should check for conflicts with the default interrupt, DMA, and I/O addresses used by the EtherLink card. If conflicts exist, the EtherShare manual gives very clear instructions for reconfiguring the EtherLink card for alternate values.

From start to finish, the software instal-

3Com 3Server

3Server is the best and the newest high-performance dedicated network file server.

The hands-down winner in PC's local area network performance sweepstakes was 3Com's 3Server dedicated network file server, which was made available to *PC Magazine* just before our editorial deadline. 3Server is a state-of-the-art replacement for 3Com's traditional AP Model disk server. It's half the price of the AP and sets a new high-water mark in the local area network price/performance race.

3Server is driven by an 8-MHz Intel 80186 processor and comes equipped with a high-performance (30 milliseconds access time) 36-megabyte disk drive, 512K of RAM, one serial port, and one parallel port. It is interfaced to 3Com's standard 10-megabits-per-second Ethernet network through an Intel 82586 Ethernet controller chip. Options include up to 986K of additional RAM,

up to six additional 36-megabyte disk drives, SDLC/HDLC communications ports, and additional serial and parallel ports. A 60-megabyte streaming tape unit can be added to back up the 3Server and any PC-XT or PC AT on the network.

The Winning Team

3Server's high performance is largely due to the pairing of its high-performance disk drive with a controller that can keep up with it. The disk is controlled by a custom-designed, bipolar-bit-slice chip that is able to service read and write requests with an interleave factor of one; in other words, one entire track of data can be read in one rotation of the disk platter. IBM's PC-XT requires six rotations to read one track

(continued)

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CIRCLE 110 ON READER SERVICE CARD

NETWORK SURVEY

lation process takes about 15 minutes if you have familiarized yourself with the documentation beforehand. *EtherShare* comes on two floppies, and an installation program on the first of these automates the process. When the installation program has finished running, it prompts you to warm-boot the system from the fixed disk. The *EtherShare* start-up menu appears, giving the you the choice of starting the dedicated mode server, switching to the standard mode, starting the administrative function, or exiting to DOS without starting the server.

After the initial installation, the server will be in dedicated mode. The next step is to run the administrative function that supports installation of expansion peripherals (such as an additional fixed disk) and network options (such as *EtherMail* and *EtherPrint*). This function also "registers" the server by giving it a name and making its existence known to any other servers on

the network. The server must be registered to activate the server function, even if it's the only server on the network. Finally, the administrative function can be password protected if desired.

After you complete the administrative activities, another warm-boot brings you back to the main menu. Selecting the first option starts the server in dedicated mode. At this point, you now have a functioning server. *EtherLink* supports *EtherStart*, a remote program load function that will allow a driveless workstation to boot from the network. (We did not review this function.) To log onto the network without *EtherStart*, you must create a network boot diskette for each nonserver workstation. 3Com scores again by making the creation of the boot diskette as painless as possible. First you make a copy of the DOS 2.x diskette, then a setup program on the *EtherSeries* User Software diskette copies additional files onto the DOS copy.

(continued)

(interleave factor of six) and the AT requires two.

The other important ingredient in 3Server's performance is the 82586 chip, which was designed by Intel in cooperation with Xerox, DEC, and other mini-computer vendors to service local area networks in commercial data processing environments. Its only design parameter was network performance. The same can be said of 3Server itself. 3Server never has to perform the duties of a workstation, and all of its memory is dedicated to optimizing disk performance and network service programs.

PC's benchmark tests of 3Server speak for themselves, but according to 3Com, a 3Server with one disk can serve up to 15 workstations in a heavy transaction load environment (for example, multi-user database or development), or

up to 50 workstations in more traditional environments (spreadsheets, word processing, and the like).

In a Small Package

3Server is tiny relative to most dedicated servers on the market. It's even smaller than a standard PC and quieter, making it suitable for desktop use in a departmental or small-company environment. The optional disk drive and tape units are identical in size and can easily be stacked.

3Com's new file server answers many of the usual objections to dedicated network servers by being small, quiet, and, most importantly, inexpensive. Add in its impressive speed, and 3Server is worth a very close look if you're looking to buy a local area network.

—John Dickinson

Using the server name as your user name, you can now log into the network, create network volumes on the hard disk, and assign user names and passwords. Since the server is in dedicated mode, you must perform these functions from a user station on the network. Following this procedure will give you a completely functioning network.

Overall, we found the installation of the 3Com hardware and software very straightforward, and the whole installation procedure is driven by short and easy-to-use menus.

The 3Com documentation is consistently superior to that of all the networks we tested. It is clear and concise, and the background material is so good that you develop a feel for how a given command should work.

One especially commendable feature of the *EtherShare* documentation—and one rarely offered by other companies—is the use of practical examples to assist in the successful operation of the network. For example, the documentation emphasizes that some programs and applications running in the foreground on the server/workstation may interfere with the functioning of the background network server task. This information is of little real value if you don't know which programs are villains. 3Com actually tells you which programs work and, more importantly, which ones don't.

The 3Com network could be described as elegantly simple. 3Com has elected to ignore, or at least avoid, certain knotty issues associated with local area networking, such as system and file access security. However, the company has adopted the few standards that exist in the network industry and has produced a product of consistently good quality. Overall, we really liked the 3Com package, even though it doesn't try to be the most comprehensive network around. ■

Fox 10-NET

The 10-NET local area network is compromised by some operational glitches, but the honing of CHAT promises smooth sailing soon.

10-NET is Fox Research's entry into the Ethernet standard local area network Olympics. It's a good thing that Fox is a research company, because it has a lot more research to do before 10-NET can be considered a full-fledged networking product for business use.

Like all networks, 10-NET has its strong points and its weak points. Its strong points center on a solid ability for the network's workstations to share the hard disk of the XT-based file-server workstation (Fox calls them "superstations"). 10-NET software operates as an extension of PC-DOS. Once the system is up and running, a workstation user is barely aware that a shared hard disk isn't attached to his own PC, and a superstation user is rarely affected by shared access to the disk.

Other strong points include the ability of any XT superstation (up to 32 can be attached to the network) to be used as an ordinary 10-NET workstation while its attached resources are serving the rest of the network. Shared resources are determined by the user, and, for example, an XT user may choose not to share the hard disk with the rest of the network. The same XT can be used in an ordinary PC-DOS mode as well.

10-NET is easy to install, requiring a level of skill normally associated with installing a home stereo system. The twist-

ed-pair cabling design with its snap-in connectors makes hooking the nodes to the plastic connector boxes a cinch; the only difficulty is the poor quality of the connectors themselves. If the wiring is strung on an office floor (as most network cables are), ordinary traffic could easily pull a connector out of a box or destroy the box altogether.

Menu-Mode Glitches

Some of 10-NET's weak points cropped up during system start-up and after the network started running on the workstation or superstation. The problems in start-up mostly involve Fox's slow-running and excessively complicated network software; its strongest tendency is to crash unmercifully at the slightest sign of user maladroitness.

Starting up the 10-NET system requires three programs: 10-NET, LOGIN, and MOUNT. The 10-NET program initiates the resident portion of the network software and identifies the user to the Ethernet interface card in the workstation or superstation PC; LOGIN identifies the PC workstation to the superstation; and MOUNT identifies the superstation devices (hard disk, printer, serial port, and so on) that the workstation wishes to have attached via the network. Why the latter two are totally separate procedures remains a mystery.

Other than its slow speed, the 10-NET command presents no special problems

once you've learned how parameters are used to identify yourself to the Ethernet card. LOGIN and MOUNT, however, are quite another story. Both of these programs can be run directly from PC-DOS in a parameter-driven mode (like most ordinary PC-DOS commands) or in a menu-driven mode. The parameter-driven modes require inputs to be entered on the command line in a precise order, separated by commas (rather than the slashes you're used to in PC-DOS commands). Most users would think the menu modes would be easier to understand and use, but they'd be wrong.

The menus provided by LOGIN and MOUNT are nearly identical, almost totally confusing, and severely deficient when it comes to information on what you've done or failed to do. The menu terminology makes PC-DOS's odd vocab-

10-NET's strongest tendency is to crash unmercifully at the slightest sign of user maladroitness.

ulary look like a kindergarten spelling bee, and even the documentation provided by 10-NET admits the complexity of LAN terminology used by the system. This is small consolation, however.

Worse, both menu programs have a strong tendency to crash if you press an offending key (the Enter key, for example). That wouldn't be so bad, except for the fact that the crashes are hard enough to require rebooting the workstation or superstation. Given that the programs are also slow to start up and operate, LOGIN and

NETWORK SURVEY

MOUNT make even an experienced user better off setting a day aside to make mistakes and learn the parameter-driven versions the hard way. Novices will want still more time.

The Hard Disk

Once 10-NET is up and running, the superstation's hard disk appears to be a workstation's or superstation's own property. PC-DOS thinks so, and every application I ran felt the same way. That's both good news and bad news.

The good news is that workstation users get the benefit of running programs and using data stored on a hard disk, although there were a few wrinkles to using PC-DOS commands. Using the CHKDSK command on the hard disk, for example, fails on a superstation, but the crash landing is a soft one; PC-DOS and 10-NET continue to operate, but you may have to change directories or the logged disk to get the PC-DOS prompt straightened out.

If, on the other hand, CHKDSK is used on the hard disk from a workstation, it crashes the user's operating system. A Fox technical representative apologized for the lack of documentation regarding the problem, and he was good enough to point out that FORMAT and PRINT are equally unsafe territories for users. He said the problem is being researched—I chose not to tempt fate by experimenting with FORMAT and PRINT.

Applications programs, such as *dBASE II*, Lotus's *1-2-3*, and *WordStar*, thought life on the superstation's hard disk was just fine and dandy. Programs could be used individually or simultaneously accessed by two users without difficulty. So could applications files, and that "convenience" could well be a rub in the wrong direction for many network users, because it's not so easy to prevent access using 10-NET's security system.

Gaps in Security

The file security system is driven by the NETSU program, and the 10-NET documentation makes it look easy enough to run and use: Individual data or program files can be protected down to the record

level by a system of security levels (ranging from 0 to 99) that is given to users of the network. Files can be protected totally or only while they are available to another user. This sounds generous, but appearances can be misleading. (continued)

LAN FACT FILE: FOX 10-NET

Marketed by:

Fox Research, Inc.
7005 Corporate Way
Dayton, OH 45459
(513) 433-2238

Retail Prices

Starter Kit	N/A
Workstation	\$ 695
Server Station	N/A
Dedicated Server	N/A
Cable (per foot)	20¢
Connector	included
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Four-Station Configuration	\$ 7,175

Hardware Capabilities

Configurations:

No. Servers	2-32
No. Workstations	2-32

Server Type XT

Memory Min./Max.

Dedicated Server	N/A
XT Server	128K
Workstation	128K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input type="checkbox"/>
RAMdisks	<input type="checkbox"/>
Other Communications	<input type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input type="checkbox"/>
Type	<input type="checkbox"/>
Global?	<input type="checkbox"/>

Network Description

Architecture	Bus
Type	Baseband
Speed	1 Mbit/sec.
Server Type	XT

Security

Logon ID	<input type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
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NETWORK SURVEY

It was only after a day of frustration that I called Fox to find out why such a simple-sounding system simply didn't work. A technical representative told me what the documentation didn't: Only files stored in the hard disk's root directory can be secured, and they can be protected only by running the NETSU program from the file-server workstation. That scenario did indeed work; any file secured with NETSU from the superstation simply wasn't available to a workstation that didn't have the proper security level. It didn't even appear in a DIR command listing. Any type of file except a subdirectory can be secured using NETSU.

Not being able to secure a file in a subdirectory means that if you prefer using the PC-DOS subdirectory system for organizing programs and files (which is, after all, its purpose) and want to make them secure in the 10-NET environment, you're out of luck. The Fox technical representative said the problem will be corrected in a future release.

What a Lapse in Security Means

Lack of subdirectory security has some ominous implications for the 10-NET system itself. Some of 10-NET's programs make heavy use of subdirectory files, and they are about as safe from arbitrary erasure as a snowflake in the sun.

The most serious systems-level problem is 10-NET's print spooler. The IOSPOOL program houses print files in a subdirectory on the hard disk of the superstation with the shared printer. Because subdirectory files cannot be secured, any user can access them and delete the spool files.

Two examples of 10-NET applications programs that are vulnerable to such erasure are 10NEWS and 10MAIL. The programs are designed to provide electronic news and mail services, respectively, to 10-NET users, and both have potentially

strong applications for business use of a LAN system, particularly if the network spans several floors or buildings. Unfortunately, both use subdirectories on the superstation's hard disk to store and maintain messages, and the messages could easily be erased by a recalcitrant workstation user seeking to destroy their business purpose.

Another 10-NET program using subdirectories is 10CAL, a tempting-looking 10-NET program that showed up on the

Some of 10-NET's programs make heavy use of subdirectory files, and they're about as safe from arbitrary erasure as a snowflake in the sun.

Fox-supplied disk and in the manual's table of contents. Unfortunately, there were no subsequent "contents" about the program in the manual, so I had to force my way through by simply trying it out and figuring it out. The program appears to be a personal and/or network calendar for scheduling meetings with network users and informing other users of your schedule. My attempts to use it failed, but 10CAL looks as though it could be helpful to LAN users.

Let's CHAT

10-NET's most useful and interesting program turned out to be CHAT. From its innocent-sounding name, you might surmise that CHAT is designed to send messages back and forth among 10-NET users. You'd be right, but way off the mark when it comes to CHAT's power and usefulness to the 10-NET user.

I discovered CHAT while trying to make the network's shared printer work. All efforts at deciphering CHAT's documentation had failed. It turned out (again, it took a call to Fox to discover the fact) that CHAT, when run from the superstation, controlled workstation access to the printer!

If CHAT did that, what else might it be able to do? CHAT is part of the 10-NET resident program and is accessed by simultaneously pressing the Ctrl and F10 keys. When the keys are pressed, a pop-up command menu appears at the bottom of the workstation or file-server screen (CHAT operates much like Borland's *Sidekick*). The menu allows you to send messages to other users and to control most of your relationship with 10-NET.

For instance, through CHAT you can activate or deactivate your link to the network, start and stop spooling print output (when you stop the spool, it is sent to the printer), abort your print queue, find out who else is on the system, and submit commands to be processed by the file-server XT.

According to two Fox technical representatives I spoke with, CHAT is being given added features all the time. I think

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datstore
Fox 10-NET	548	219	N/A

Fox should provide additions to CHAT that will allow the company to do away with most or all of the other commands in its 10-NET system. The program is easier to use, more accessible (it doesn't require the network floppy disk to be in the logged drive), faster, and friendlier than anything else in 10-NET.

Printer-Sharing Issue

Sharing a printer with 10-NET works well, with two troublesome exceptions. As mentioned above, the print spool files are stored in a subdirectory and cannot be secured from damage by an unauthorized user. The other flaw is that the workstation or superstation that has the printer attached has top priority; it can clobber another job being printed by doing something as innocent as a Print-Screen. According to Fox representatives, there is currently no way to overcome the problem.

A plus in the arrangement comes from the disk-based spool drives. Because of that, a print job will not have to be rerun if the network comes down (at night, for example). It also means you can repeat a print job (perhaps salvaging a report ruined by the printer host's Print-Screen command) and reorder the sequence of printing without losing work or time. Both workstation and superstation access and use of the spool and printer are most easily done through CHAT, although print-job reordering requires use of 10SPOOL's menus.

Fox Research's 10-NET is by no means a bad system; it's just not as good as it could be. Inside, there is a better product waiting to emerge. The company has the basics—as evidenced by the fact that its underlying system software never crashed during testing—but it needs to clean up 10-NET's front end and strengthen security. As I said, all Fox has to do is let CHAT operate the whole thing, and it'll have a winner on its hands!

Where Are Your Files?

Networks give you scope and power, but shared files can also clobber each other. Here are strategies for safely sharing files.

Networks serve two purposes: to bring users together and to reduce hardware redundancy. When users are linked electronically, they are able to send and receive information faster than those who must rely on passing diskettes from office to office. Similarly, sharing space on a hard disk makes the large, economy-size disk more practical, bringing down the cost for all.

A multi-user system, however, must be more intelligent than one intended only for single users. It must prevent the messages of different users from colliding and ensure that files aren't accidentally damaged as a result of disk sharing. Message collision is a simple hardware problem. File "clobbering," however, has been the bane of multi-user systems for 20 years, yet some interesting techniques have evolved for combatting it.

Disk Sharing

If seven users wish to share a 70-megabyte disk, instead of each having a separate 10-megabyte disk, a simple disk-sharing scheme might involve partitioning the hard disk into seven physical areas or "virtual volumes" and assign-

ing each volume to a different PC in the network. Users might get a little more or a little less than 10 megabytes, depending on their actual needs. You might even find that the seven users would be perfectly happy on a 50-megabyte disk.

In one office, Mr. Barnum can put his files through their paces, while Mr. Bailey, in the next, does likewise, with neither having to worry about what the other is doing. Each workstation becomes its own ring in a multiring circus.

But is it really necessary to prevent users from even reading a file on someone else's volume? Suppose there's a help file or a ZIP code table? It would be nice to collect all such read-only files in their own volume and grant everybody—or almost everybody—read access to them.

You can accomplish this simply by differentiating between private volumes, which belong to one user, and public volumes, which belong to all. Of course, you'll have to expand your table of volume users to allow multiple users access to a particular volume.

Public volumes can't be read-only to everyone, or they'll never get updated. So you must define not only volume

Dean Hannotte

classes but also the access rights or "permissions" that various users have to them. In most cases, it will be enough to grant one user—usually called the owner—write access to any particular public volume. Determining when the updates can safely take place becomes a new problem.

What if Barnum's PC is down and Bailey is taking a few days off? It would be nice if their machines were somewhat interchangeable. For Barnum to get to his files from Bailey's PC, however, he'll have to convince the network that he is in fact the user associated with the PC that is down. For a network to provide this flexibility, it must be designed to ask the user first for his or her name and then for a password. This sign-on sequence must always be required of all users before they are given access to any part of the hard disk.

File Locking

To exchange actual data in such a system, Barnum and Bailey must invoke a file-transfer utility that locks both their keyboards while it copies a file from one volume to the other. Not only does this fluster Mr. Bailey, but it duplicates the amount of data actually needed. Why not simply take turns with the same RECIPE.FIL?

When Mr. Barnum goes to the public library to take his turn reading the latest Hollywood biography, he brings the book home with him so that no one else can use it. But in a network, data always stay on the hard disk, and thus there has to be another way of telling other users that the data are in use.

You can prevent other users from modifying the file you're working with by adding code to various software levels. If everyone in the network uses a

single integrated package, that package can be the arbiter of file access, maintaining its own internal table of who's got what. That's unlikely, however, since almost everyone makes alterations by copying, renaming, or erasing.

What you really need is a change in the operating system—or at least the network—so that multiple accesses of the same file will cause an error message to appear. There are two ways to do this: explicitly and implicitly.

Explicitly, Barnum might ask the system to acquire RECIPE.FIL. If Bailey is looking up apple pancakes, the system could respond FILE BUSY; if not, FILE

Think of a file server as a black box sitting between the hard disk and the network, granting and denying users access to files.

ACQUIRED. Notice that it's not enough for the ACQUIRE command to keep an in-core table of who's got what. In-core memory is different for each PC in the network, which defeats the purpose of global file management. Somewhere, someone has to have such a table that is valid for all.

Hence the concept of the file server, which arbitrates access. Think of a file server as a black box sitting between the hard disk and the network, granting and denying users access to files. For each ACQUIRE attempt, the server has to

make sure the file is free, exchange its table entry, and send approval back to the requester. This doesn't really slow down the hard disk, since it can only do one thing at a time anyway, and the traffic cop operates at CPU speeds.

Once we have a server, we can add some nice touches. For example, suppose the hard disk has just finished a time-consuming function and finds two ACQUIRE commands waiting for it. If told to do so when installed, it can give the edge to the user who is considered to have higher priority—Mr. Barnum in this case. And rather than buying a nanocomputer to run the black box, you can simply add some file-server software to one of your PCs and hook that up to the hard disk. Finally, you can simplify your record keeping by using an unused bit in the existing DOS file directory rather than creating a whole new table.

One problem not yet solved is that of file growth. Unfortunately, when DOS opens a file, it reads the file allocation table into RAM and leaves it there until the file is closed. Sectors appended to the file are reflected only on the local node PC, making duplicate sector allocation possible. You'll need a way to prevent added records from overlapping when two users acquire two different files and start adding records to them. It helps to preallocate a larger file than necessary, but only if the application can be prevented from attempting any expansion.

Once the system can keep track of files being used, you can simplify your scheme. Make the acquire function an implicit part of the open processing that every program must invoke before reading from or writing to a file. Thus, just by loading 1-2-3, Barnum will automatically acquire the file he needs. Of course, it would be nice if 1-2-3 could distinguish

between a can't-open and a can't-acquire condition and tell Barnum which error actually occurred. But, if J-2-3 fails to do this, Barnum can issue the ACQUIRE command manually to get the appropriate error response.

Explicit acquisition operates through the ACQUIRE command that comes with an off-the-shelf network package, but implicit acquisition is messier because it means putting "hooks" into DOS. Of course, it helps if this kind of network function is built into the operating system to begin with, but for microcomputers that's asking a lot.

Record Locking

Now that you have several reasonable ways of allowing users to lock files, what can you do about the individual records in a file? What if there's really only one large database, with three or four people updating it all day long?

This case would call for a much more complicated—and dangerous—approach. Records, especially record hierarchies, are so application dependent that it is often impossible for anyone but the application programmer to determine the optimal locking strategy. To simplify the job, most multi-user systems provide for a kind of symbolic support.

When the operating system can't determine what kinds of things must be locked out (they can be records, sector chains, or entire subdirectories), it allows the application to allocate and release "named resources." A particular application, for example, might decide that the symbolic name for each individual record in its database will be DB-REC:NNNNN, with NNNNN being the physical sector in which the record resides. Before reading a record, any program in the application will call the

operating system's resource manager and request an allocation.

Notice how crucial the unit of allocation becomes. Since the unit of I/O in DOS is the physical sector, it is not enough to claim transient ownership of a single record if another user already owns a different record in that same sector—a situation that's bound to occur

When the operating system is unable to determine what kinds of things must be locked out, it allows the application to allocate and release "named resources."

eventually. Whoever rewrites the sector list will erase any changes that the other user just tried to make.

What should happen when a record is locked out? In polite society, people are willing to wait in line for short periods rather than do without. In a LAN, it may be appropriate for the application program to wait a second and repeat its request—and to try this several times—before telling the user that the record is unavailable.

In unattended applications, the request loop is infinite, and it is even possible for applications to deadlock one another when they need to lock more

than one record at a time. If one program locks record 20 and then asks for record 30, while another has already locked 30 but is waiting for 20, neither will be able to proceed.

This allocation is symbolic in that the operating system merely looks for the name in its internal table of allocated resources, and if it's not there, the system adds it to the list and sends its okay back to the application program. The operating system doesn't know what resource the application program is talking about, but the trick works anyway. The system simply raises a flag—or semaphore—and goes about its business.

Of course, semaphore processing requires enhancements to DOS, some of which I expect in DOS 3.1. But the necessary enhancements can also be made by network vendors who know what they're doing. Adhered to diligently, and backed up by a few more checks and balances, these semaphore schemes do work.

Important Goals

Local area networks typically rely on one or two of these file-sharing strategies and operate within the restrictions they necessitate. In contrast, large multi-user systems often use all of these strategies at once. On gargantuan mainframes, the problem is compounded by the need for "checkpointing," or backing up, the day's work as it progresses. Once software becomes this complex, program serialization and even data redundancy are attractive alternatives.

Increasing the availability and the timeliness of data will continue to be important goals. The complexity and the power of file-sharing algorithms are limited only by human imagination.

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Steeleware DB Master	195.00	148.00
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1110 Burnett Avenue, Suites J & K
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AST-PCnet II

AST-PCnet II, an easy-to-use network for small- to medium-size businesses, does its job with speed, intelligence, economy, and elegance.

A computer network can be harder to organize than a revolution. With that in mind, it's no wonder networking remains almost exclusively the realm of big business. Although networks can also help small- or medium-size organizations, only big organizations have systems departments capable of thrashing through the intricacies of its installation. Professional offices and small businesses usually don't have the in-house expertise or time needed to start a network running.

AST-PCnet II is one network that even naive users can set up themselves. You don't need a structural engineer on staff to help install the cabling. This system hooks up to a telephone wire. Nor do you need a doctorate in electrical engineering to decipher schematics that look more like hieroglyphics than instructions. AST-PCnet II is nearly as simple to install as ordinary PC peripherals such as multifunction boards. Nevertheless, the finished system can handle both the light and medium file-exchanging traffic of moderate-size businesses or departments of large organizations.

Although AST Research Inc., proudly claims that PCnet II is capable of handling up to 160 separate workstations or "nodes," those numbers can be somewhat misleading. The largest practical number of users depends to a very large degree on

network usage, particularly file access.

The biggest limitation on the network is its relatively modest (at least in comparison with more elaborate and expensive systems) operating speed. AST-PCnet II shifts data around at 800 kHz. That's three times faster than a floppy disk but about one-sixth the speed of a hard disk. As you would expect, programs passed through the AST-PCnet II system from a hard disk will load noticeably faster than those originating on a nonnetworked floppy disk, but slower than those from an individual hard disk. For file sharing among several cooperative users, it should be fast enough, at least when using systems without heavy disk-access demands.

Versatility Within Limits

Within its limits, the network possesses quite unusual versatility. If you don't exceed its maximum number of workstations, you can connect more than one network to the same cable. Breaking one network into several on the same cable will not increase its total capacity. This happens because all workstations connected to the cable operate within the same bandwidth, even though they may belong to different logical networks and must be assigned addresses from within the same limited range. Moreover, each additional station that you attached to a cable will lower performance of all the networks sharing that cable.

As with any network, performance can

be boosted if all users follow a few fundamental rules for keeping network time to a minimum. The AST manual offers a few hints on how to use the system without creating congestion. For instance, when doing intensive work, you can transfer files from a shared disk to one not linked to the network.

Not Quite a Network

In some regards, AST-PCnet II does not rate as a complete networking system. Rather, it consists of an open-architecture hardware arrangement for file sharing. It is a foundation on which a network can be built.

The software accompanying the AST-PCnet II hardware is sufficient but minimal. This is by plan rather than by omission. You get the necessary utility programs to bring the system up, to share files between user and server stations, to share printers and spool print jobs, and to set up a system clock. Nothing more.

Rather than locking everyone into one software system, which may or may not be the right one for you, AST lets you do the shopping and find the features you need elsewhere. AST provides the hardware to bring the network to life and leaves the controls to other software suppliers. (A short list of companies writing software particularly for AST-PCnet II is included in the system's manual.)

The hardware-only orientation is a valid approach for a company such as AST that specializes in personal computer peripherals rather than in software. The only shortcoming to building your network this way is the time that it takes to discover and implement the right software. Even so, the time is well spent and can save you headaches and heartaches later on.

The system comes with more than enough software to get you started, however, and it may be all you need for many

NO GUTS, NO GLORY.

Parallel port included. Standard interface for popular printers.

Five full-length expansion slots for IBM PC/XT compatible option cards. Hard disk machines with 640K, real time clock, three I/O ports and display has two slots free.

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NETWORK SURVEY

applications. The PCs in the standard system can exchange data in files or share the use of certain disk drives. Printers attached to individual PCs can be shared by the whole network, and several files from an assortment of stations can be queued up to pour out of any printer. The supplied software even allows some degree of remote control, including running programs from one station on another.

In comparison, full-fledged networks allow individual workstations to send messages directly to one another, offer greater freedom in operating printers, and usually supply more overall control. All of these functions can be added to AST-PCnet II with outside software.

Servers

AST-PCnet II's standard arrangement divides all computers in the system into two classes: uPCs and sPCs (a uPC is a "user" workstation and an sPC is a "shared" workstation—generally known as a file server). Either type of PC can be any full-size IBM computer—PC, XT, AT, or portable.

The only specific equipment required at any workstation or node is 128K of RAM and at least one disk drive. According to AST, the current version of the PCnet II hardware and software lets you use any mass storage device, including hard disks and tape backup, and any other hardware that will function with DOS 2.1. You don't need a hard disk at any of the network servers, but using one is advisable. (The network was tested with an XT functioning as the server and three PCs

equipped with standard IBM hardware.)

To optimize its performance, AST-PCnet II uses both interrupts and a DMA (direct memory access) channel as well as certain port addresses in each PC. The network hardware comes set up to function, without modification, with standard IBM

A server is a computer that can allow other computers access to its disk drives, while a user is a computer that can use its own disks or the disks of one or more servers.

equipment. However, some third-party peripherals use the same interrupts, addresses, and DMA channel that AST-PCnet II prefers. This could result in erratic operation of the network and the peripheral (or the peripheral alone) when these devices are used with PCnet II. Most of these conflicts can be resolved by reassigning PCnet II functions or by changing jumpers on the PCnet II expansion cards. It was my good fortune that the AST-PCnet II hardware used in my tests arrived set up to work with an all-IBM system. It

did so without a problem.

The user and server assignment of any particular workstation is defined by software and a single switch. Every station in the system gets an identical AST-PCnet II interface card. In normal operation, the only hardware setting that must be made is a single DIP switch, which assigns a separate and distinct identifying number to each station. Users and servers are required to choose numbers that are in different ranges.

A server is a computer that can allow other computers access to its disk drives, while a user is a computer that can use its own disks or the disks of one or more servers. These possibilities become real with the aid of a special program that runs only on a server. In most cases, it need only be run once, when the network is set up.

The server allows read or write access to its drives by any other station in the system. However, one server cannot access the files of another server unless both servers allow access to a common user, which acts as an intermediary. The server can access the user stations' shared files but cannot access drives physically installed in user stations.

The program for assigning disk access between the server and user is menu driven and can be invoked at any time to change the permissions of any station in the system. By answering Y or N to the appropriate on-screen prompts, each station is independently assigned read access and write access to each drive of the server's station.

User Stations

The user stations must run setup programs to determine the drive letters assigned to the disks for which access is allowed. These can also be reconfigured at any time. However, the information is loaded into a data file that automatically loads at boot time, meaning that once the

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
AST-PCnet II	940	226	168

information is entered, no one ever needs to bother with it again.

User stations can run programs on server stations—if they are set up with the proper permission—using a special command (RE, for remote operation). However,

only simple programs that don't require input not on the command line can be controlled this way.

In addition, the network software allows you to define one PC server's clock as the system clock and to set the internal

clocks of the other computers in the system to it.

Hardware

AST-PCnet II uses twisted-pair cable, probably the cheapest wire for linking a computer network. An added advantage is that twisted-pair wire makes even the grunt work of the AST-PCnet II installation easy.

Although standard 15-foot long telephone cables are used to connect stations to the main network cable, ordinary phone wire is not recommended for PCnet's main cable. Rather, AST advises using a special (although not exotic) 175-ohm wire that is available either directly from AST or through most electronic suppliers. AST warns that mismatching the cable may cause data loss, but this is unlikely to occur in short runs.

RJ-11 modular telephone jacks connect your computer to the network. There's one on the system cable terminal block and another on the back of your PC. You can plug and unplug stations as simply as you do a telephone, and you can even do it while the network is operating.

Probably the hardest part of the entire installation process is running the main network cable. Depending on the permanence of your operation and your standards, you can run the cable through the ceiling or string it through the aisles between desks as a trip wire. In any event, of course, slinging wire around—no matter how cheap or how simple—is something that's always easier to have someone else do.

Standard telephone-style junction boxes can be attached to the system cable in as many places as your specific network configuration requires. You don't have to be an electrician to splice in the connecting blocks, either. Wiring is so simple that you could hire any 5-year-old who is reasonably familiar with the textbook *Rusty*

LAN FACT FILE: AST-PCNET II

Marketed by:

AST Research
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333

Retail Prices

Starter Kit	\$ 1,090
Workstation	\$ 495
Server Station	N/A
Dedicated Server	N/A
Cable (per foot)	included
Connector	N/A
Repeater	\$ 595
Four-Station Configuration	\$ 6,375

Hardware Capabilities

Configurations:

No. Servers	no max.
No. Workstations	2-160
Server Type	Both
Memory Min./Max.	

Dedicated Server	N/A
XT Server	128/640K
Workstation	128/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Tape and Disk	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Bus
Type	Baseband
Speed	0.8 Mbit/sec.
Server Type	XT

Security

Logon ID	<input type="checkbox"/>
File Passwords	<input type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input type="checkbox"/>
Network/Station	<input type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input type="checkbox"/>

Applications:

Electronic Mail	<input type="checkbox"/>
Chat	<input type="checkbox"/>
Utilities	<input type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
RAM- and Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

Rings a Bell to hook things up. At each junction block, you simply follow the two-wire color code. If you can match black with black and red with red, you've got it down.

System topography, a distributed bus, is as simple as a straight line. Unlike some networks, PCnet II leaves no loose ends to be tied together, and no stars or clusters to worry about. The only requirement is that the network cable pass near enough to each computer to allow connection. Adding terminators to each end of the main system cable is the only part of the installation that is at all complex.

AST allows for a maximum length of 500 feet for the system cable itself. Longer runs require one or more repeaters, which essentially loop the system cable through a computer. To stretch the system to its maximum length of 2,500 feet, you can add repeaters at distances of approximately every 500 feet.

Every PC, user and server, requires the same network interface card to use AST-PCnet II. The card is about two-thirds of a full-length card (about 10 inches), and the double-sided card is cleanly and neatly executed. The open layout and the fact that it doesn't need last-minute modifications—jumpers and extra parts—attest to the professionalism of its design.

Installing the card is as simple as sliding it into a vacant expansion slot and screwing it down. Then the network hook-up must be plugged into the single jack on the retaining bracket of the card. Once all PCs in the system have their interfaces installed and plugged into the network cable, you can begin software installation.

Sorting Through the Software

AST attempted to make PCnet II's software installation as easy as its hardware installation was. Most of the difficult work is handled by batch files and menu-driven

Network Security Issues

When you set up a network, it's important to consider how to safeguard your files. But solutions to the problem can vary.

A desire to safeguard data in your local area network isn't a sign of personal insecurity. Whether the data are personnel records, business files, or just drafts of memos, you certainly don't want to lose them, you probably don't want anyone to erase them, and you may not want your coworkers to read them.

The first level of security is physical—you have to make sure that you don't lose your files because of hardware failures, power outages, or use of your terminal while you're not around. The problems and solutions on the physical level are the same as they are on stand-alone machines. And making sure nobody pulls the plug (or turns off the server or another machine where your file will be stored) during operation, good maintenance, and frequent backups are some of the first-line defenses against security problems.

The next-highest level of security is limiting access to your files during normal operation. Most networks using file servers offer one or more levels of password protections. This requires you to

give the correct keyword before you can logon or use certain files. Some less-sophisticated disk-server systems don't offer this feature or allow application programs to ignore any of the protection flags set by the network.

Levels of Access

Increasingly, password protection systems for LANs are offering levels of access rather than absolute authorization or denial. In most implementations, you can assign various permissions to a file, allowing others to read the file, write to it, execute it (if it's a program file), or remove it. You may, for example, want to allow any user to write to a suggestion box file, but allow only the system manager to erase it.

Password protection is relatively secure against casual browsing or mischief, unless, of course, you leave your password taped to the side of your PC or pick a fairly obvious choice (studies show that most people pick such an obvious word that a coworker usually can guess it in about a dozen tries). Password protection, however, is completely ineffective if someone can bypass the network to read your files.

Steve Rosenthal

If your network uses a distributed server philosophy (where the file storage for network-accessible files is spread among the machines on the network) or if your dedicated server machine can also be booted up as a standalone workstation, then an interloper may be able to boot up a machine in standalone mode to join access to your files. Networks that use a proprietary file structure are more resistant than networks that use standard DOS files, but no network password scheme should be considered secure against someone who can hack at the system in single-user mode. Just as you protect files on standalone PCs, the simplest way to deal with this problem is to lock machines that contain valuable files when the network isn't in use.

To be sure that your files can't be read by unauthorized users, regardless of the network type, encrypt them. Even if unauthorized persons can access a file, they still won't be able to make sense of the contents. Western Digital, for exam-

To be sure that your files can't be read by unauthorized users, encrypt them.

ple, makes a Data Security Board that scrambles your files using the federal Data Encryption Standard (DES). The company says it has successfully tested the board with several networks. The DES coding guarantees that it would take someone days of work on a supercomputer to read your file without knowing your encryption keyword. ■

programs. Even backing up the distribution diskette is a one-command, batch-file-driven operation. The manual not only gives instructions in understandable text, but also accompanies them with decision-tree flow charts. The system should be foolproof.

But I had problems with it anyway. I tried to wrestle with the instructions by sight-reading, but this particular installation-manual-and-software combination requires more of a Gestalt approach. For instance, the manual says you can make a floppy-to-floppy backup on an XT (which has only one floppy drive). I didn't have much success at that. Fortunately, you can usually find a two-floppy PC lying around somewhere, quickly disposing of that and similar problems.

The next job is to create a boot disk for each workstation, and this is simply a matter of using DOS to format each disk and then running a program and responding to its questions. (There are separate programs for user and server boot disks.) Next, you configure the server using a menu-driven installation program. Finally, you use a similar installation program to configure each individual user PC. (These programs must be run on the user PCs.) The network then is operating.

In my testing, the first software disk AST sent was defective and failed to produce working boot disks. The replacement copy allowed me to set up the network software in a few minutes, with no problem.

Share and Share Alike

Once you have set up the network, normal workstation operation differs only slightly from standalone PC operation. The workstations' natural disk drives are accessed through the use of their DOS-assigned drive letters such as A:, B:, C:, and so on. The shared disk drives are accessible at the letters where the worksta-

tion's internal drives leave off.

To retrieve or send a file to a shared disk, it is only necessary for you to use the shared disk's drive letter in your com-

Once you have installed the AST-PCnet II network, normal workstation operation differs only slightly from the way you would operate a standalone PC.

mands. You can even log onto a shared disk and use it as the default drive. If read and write access has been granted by the server PC, then the shared disks differ from ordinary floppy disks simply by being faster and lacking removable media. Of course, should access be limited to reading or writing, the disallowed disk functions won't work.

AST-PCnet II is generally genial, and it has no problem allowing several workstations to read from the same file at once. Problems can arise, of course, when two stations try to write to the same file simultaneously.

To protect against jumbling records in this situation, the AST-PCnet II software includes a "locking" feature. With AST-PCnet II, locking is a simple semaphore system. A file to be protected is "flagged" so that other stations know it is being used. The flagging is cooperative, and each station accesses the file only through the locking system.

(continued)

NETWORK SURVEY

You can easily circumvent this semaphore system, however, both intentionally and accidentally. Even when a file is locked and in use by another station, it can be modified or even deleted with normal DOS commands issued from any workstation with read-write access. Although this protection system is not foolproof, it may be enough for a small system. If all the rules of the locking system are cooperatively obeyed, the system will prevent access to a file by more than one workstation at a time, avoiding confusion of the retained data caused by more than one station writing to the same file at the same time.

The protection software also includes a special provision of the locking program that, should it run into an already locked file, regularly retries to access it until that file is unlocked. The special program then takes over the file and locks it for the new user. Hence, you need not constantly poll the server waiting for it to unlock the file you want.

Hazing the System

Of course, you may forget to lock a file. To determine the consequences of such a misdeed, Glenn Hart and I, working together on the network, held a demolition derby. We called up individual copies of *WordStar* on two different user PCs, and edited the same file on the shared disk. After creating two distinct versions of the file, we attempted to enter the *SAVE* command at exactly the same time.

When the smoke cleared, only one of the edited files was left on the shared disk. The text was mine. After a little scouting we discovered that the backup of that file was Glenn's version. Obviously, *AST-PCnet II* was smart enough to write one file at a time, close it, and then give *WordStar* control to write a new version and move the old one to backup. And, obviously, then, I had lost the race.

It was still a couple of days before Halloween when Glenn and I ran through our manual of dirty tricks on the *AST-PCnet II* system.

For starters, I nonchalantly sneaked up behind the server XT, whistled softly under my breath, and suddenly lashed out and switched off the machine. As the

AST-PCnet II software is an excellent traffic cop, carefully mediating disk access among the workstations. I was unable to create a data gridlock on the network.

green faded from the screen of the server, there was no observable effect on the user stations—certainly no warning that anything had changed in the network system. When I went to a user station and tried to access the now-dead server, I was rewarded with a "disk not ready" error message: "abort, retry, ignore."

By this time, I was in a mean, spiteful mood, so I ordered a retry and switched the server back on. As soon as the server came up to speed, the user PC had shared-disk access again. No fuss, no muss, and no spilled blood. *AST* gets an A+ for elegant recovery from failure of the server station.

With some simple networks, a user can do a dastardly deed on the rest of the office simply by calling up a directory and stopping the on-screen scroll of file names by

pressing the *Ctrl-Num Lock* key combination. To see if this was true of the *AST-PCnet II*, I went to a user station and performed the necessary black magic, lodging half a directory on the screen. To my amazement, all the other stations still had perfect access to the shared disk. The effect was the same when I stopped the scroll on the server. Thus far, the network was very impressive.

Next, Glenn and I drag raced. We each took two stations and carefully worked our way to the starting line by accessing the same directory on the server from each station and then typing in the program's name. At the sound of the starter's pistol, we pressed the *Enter* key on each machine.

The server won, and the program immediately rolled down its screen. Even before the program had finished its initial displays on the server, it was scrolling down the screen of the second PC. The next two stations rolled the program's initial display down at about 2-second intervals. As soon as one station finished loading the program, it proceeded to load on the next.

Irrked at being unable to ruffle the network, I became more devious by the minute. In a fit of creative writing, I concocted a recursive five-line program that did nothing but endlessly and continuously write characters to disk. Once the program started, it attempted to overtake the hard disk on the server and hold on. Then I called the same program on the same disk from another station in the network, and executed it, again trying to access the shared hard disk continuously. The workstations took turns holding on to the hard disk, just as they should.

Finally, I ran the same program on all the stations in the system, including the server, all accessing the same file on the same disk drive. The stations took turns using the disk. Access was denied to each

of the workstations in the system for 1 to 4 seconds, but all stations had access for an equal amount of time. In the long run, each station was able to write the same number of records to the hard disk.

I was forced to admit that the AST-PCnet II software is an excellent traffic cop, carefully mediating disk access among the workstations. Despite my best efforts, I was unable to create a data gridlock on the network.

One place you would expect a network with a nondedicated server to pay a performance penalty is in the server's data processing speed. Because its CPU must divide time between servicing the network and running its operator's programs, performance has to suffer. To get an objective measurement on the degradation in the server's abilities, I gave the server a CPU-intensive task—calculating the square root of two to 1,000 decimal places (in IBM Logo)—and measured the time necessary for the calculations. Just 3 minutes and 32 seconds later, I got the answer.

I then ran my continuous access program again, to give the server a worst-case network load. This substantially increased the time necessary for the square-root calculation—to 8 minutes and 56 seconds. Clearly, a mere XT will have its hands full with heavy network traffic.

The converse effect—the degradation of network performance when the server's CPU becomes busy—turned out to be less substantial. One hundred iterations of my continuous-disk-access network clogging program required 18.40 seconds when the server was idling. Setting the server crunching away at the square root of two added just 1.12 seconds to the run time.

Printing

AST-PCnet II allows the sharing of up to three printers, a limitation based on the network's conformance to DOS rules (PC-DOS supports only three printers at a

time). Each printer can be located at any node of the system and accessed from any other node in the system. Additional printers (more than three) can be installed in the network, but they must be accessed only by individual workstations and cannot be shared.

Once the network has been installed,

Within the limits of the software supplied, AST-PCnet II is an able performer. Despite its relatively slow data rate, it should be sufficient for many applications.

accessing a printer is as easy as giving a normal printing command from a program or from DOS. The one important exception is that the network requires more specific information about the print job, including which printer to use. Moreover, the network needs to know when each print task ends because neither it nor DOS has an automatic way of recognizing the end of the print job.

To convey all this information, you need only end your print job with a single additional command (a three-keystroke combination). The command marks the end of the job and directs it to the requested printer.

The AST-PCnet II printing software spools all print jobs together for each printer in an individual queue. While awaiting printer access, the information is stored in

a temporary disk file in the PC controlling the printer. These files then are sent to the printer on a first-in/first-out basis. You can also assign one of three priority levels to each print job, and the system will then print all jobs of higher priority before starting on those of the next priority level. To avoid confusion, however, higher-priority print jobs are not permitted to interrupt lower-level jobs in progress.

AST also provides software for managing the printing chores. For instance, should you have second thoughts about a print job, you can cancel a job from the print queue or raise its priority with relatively simple commands. Another program displays a chart of all pending print jobs.

The printing management software even has a limited amount of security built into it. A job can be altered or canceled only by the station sending it out to print and the station controlling the printer it is using.

Conclusions

Within the limits of the software supplied, AST-PCnet II is an able performer. In spite of its relatively slow data rate, it should be sufficient for many applications. Its weakest point is probably its rudimentary, semaphore-style file-protection system. Its strongest suits are its low cost, ease of installation, and user familiarity. Anyone who knows the basic DOS commands can easily learn the shared facilities of the network.

If your networking requirements are typical of a small professional office, a small- to medium-size business, or an in-house department with a moderate number of workstations—sporadic file sharing and ordinary print queuing and sharing—AST-PCnet II should be both fast and smart enough to do the job for you. In addition, it will do its work elegantly and relatively inexpensively. ■

Corvus Omnishare

Despite some unnecessary complications, this network fulfills its purpose, linking a few PCs to share a hard disk.

The Corvus Omninet was among the first local area networks for the personal computer on the market, and it is still the most successful in terms of installed systems. We tested the Omnishare version, which is specifically intended to connect a small cluster of PCs or compatibles to an XT to share the XT's hard disk. The network also allows you to share printers through a dedicated print server. For a product with these modest goals, Omninet performs well, is reliable, and sells at a modest price.

Omnishare is somewhat unusual in that it has no dedicated file server; in effect, the XT whose disk is shared is just another workstation that happens to house a resource of interest to others. But until Big Blue came down from the mountaintop recently to give its blessing to low-cost local area networks (LANs), Omninet was the closest thing to an industry standard. It's no wonder, then, that this LAN readily runs popular single-user applications for the IBM PC. *WordStar*, *1-2-3*, and *dBASE II* operate normally, except for the obvious problems generated by the copy-protection schemes in the latter two programs, which require that you mount a vendor-furnished diskette in the workstation's

drive A:. These problems occur with many networks; they arise from the way the applications are structured, not from the networks themselves.

Conspicuous in Their Absence

This network offers little in the way of file security. If you put a *WordStar* file on a fully public volume, for example, anyone on the network can read it, add to it, or erase it, and two or more users can manipulate it concurrently without realizing they're in conflict. Whoever saves his or her work last is the one who "wins." This situation also holds true for most other applications we tested. Like the problem of having a copy-protected disk in drive A:, it's a shortcoming of the applications designed for a single-user environment, not of the network itself. With Omnishare, the only way you can keep files you're working on away from other users is to move them to a private volume during update.

The network does establish two levels of access for public volumes: read-only and read/write. The network manager also establishes the volumes each user can access. Access to a file is entirely a function of access to the private volume that contains it. When logging on, the user must supply an I.D. and a password, but

Omnishare allows multiple users to log on with the same name and work on the system simultaneously.

Omnishare also lacks a true electronic mail capability. Corvus has attempted to remedy this situation by allowing you to generate a message from within another program such as a word processor, and then send that file to the utility server just as though you wanted to print it. The recipient can then retrieve the message from the server with a menu choice under the DESPOOL command (rather than the originator using DESPOOL to print it). While this arrangement makes it possible in a crude sense to send messages across the network, it's unwieldy and impractical as a substitute for electronic mail. No "mail waiting" indicator prompts a recipient to check the pipe area, and nothing prevents an unauthorized user from fetching messages intended for others. Also, once a transferred file has been viewed at the console, it's gone forever; if you think you might want to keep it, you have to print it or save it in one of your own files before you view it on the screen.

Network Management

Omnishare accommodates up to 26 virtual disks, all of which are actually subdirectories in one giant real volume. This is not apparent to users, nor even to the system manager. The floppy drives at each workstation are always drive A: and drive B:. The virtual hard disk volumes are known to users as the familiar C:, D:, E:, and so forth, making it seem that this is standard DOS. The system management utilities allow the system manager to establish and modify the tables that grant individual users access to up to 10 "mount units," or specific virtual volumes. The system manager can add new volumes at any time, so long as the maximum of 26 has not yet been used up.

Omnishare's network management is

Kent Porter and Steve Kanzler

more difficult than it needs to be. For one thing the system control utilities are "hidden" and require a complex sequence of operations to enter; presumably only the privileged know the secret combination that unlocks the magic of system control. First, you have to cold-reboot the workstation with no diskette in drive A:. This brings the unit up in ROM BASIC. You then type a short, cryptic, three-line BASIC program that "wakes up" the network management system.

The management utilities consist of an extensive hierarchy of menus that lead to the function you want to perform. The main menu gives an overview of the available functions:

- D-Drive Management
- B-Backup Utilities
- M-Maintenance Utilities
- U-Utility Server Manager
- T-Transfer Manager
- I-Initialize Drive
- L-List Drives
- H-Help

From this menu, each choice loads a new program from the hard disk. Some of the submenus also chain to yet other programs. Apparently there's a great deal of overhead in passing from one program to the next, because long delays occur between menus, giving the impression of sluggishness. Nevertheless, the utilities are very powerful, and the *System Manager Guide*, the thickest of the Omnishare manuals, does an excellent job of documenting how to use the system, including some practical sample sessions.

Corvus supplies its own backup option, XT Mirror, which allows part or all of the hard disk to be backed up to a cartridge. We did not test XT Mirror, but we did use an alternative Omnishare utility called IBMBACKUP for backing up hard disk volumes onto floppy disks and also for restoring from floppies. The entire process is menu driven and contains facilities for

listing all the hard disk volumes. Also, since the procedure can run for quite a long time (upwards of 20 minutes), the system reports what it's doing to reassure the user that something is happening.

Mainframe communications are sup-

ported by the SNA gateway, which connects to the Omnet bus, allowing file transfer to and from any mainframes that support SNA. The product includes software written by the Systems Center in Dallas.

(continued)

LAN FACT FILE: OMNISHARE

Marketed by:
Corvus Systems
2100 Corvus Dr.
San Jose, CA 95124
(408) 559-7000

Retail Prices

Starter Kit	\$ 795
Workstation	\$ 495
Server Station	\$ 990
Dedicated Server	\$ 990
Cable (per foot)	25¢
Connector	\$ 495
Repeater	\$ 150
Four-Station Configuration	\$ 4,125

Hardware Capabilities

Configurations:	
No. Servers	1-63
No. Workstations	1-63
Server Type	Both
Memory Min./Max.	
Dedicated Server	5/45 MB
XT Server	N/A
Workstation	64/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input type="checkbox"/>
RAMdisks	<input type="checkbox"/>
Other Communications	<input type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Tape and Disk	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Bus
Type	Baseband
Speed	1 Mbit/sec.
Server Type	Dedicated/XT

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input checked="" type="checkbox"/>

Software Capabilities

Operating System:	
Disk Caching	<input type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input checked="" type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
RAM- and Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>
Tape and Disk	<input checked="" type="checkbox"/>

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THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
Corvus Omnishare	1058	137	196
Corvus Novell	391	123	89

At the Workstation

The Omninet workstation hardware consists of transport boards installed in each workstation, with drop cables to transceiver boxes that connect to the RS-422 twisted-pair bus cable. It doesn't require much technical skill to install the hardware. You simply open the machine's cases, set some DIP switches, and plug in the board and drop cable. The instructions that come with the boards are adequate, but they contain some inaccurate information on switch settings. You cannot assume that the board switch settings are correct, since they come randomly set from the factory. You have to refer to the accompanying errata sheets. It's also necessary to set a unique hardware address for each board. The installation guide furnishes advice and planning aids to help in performing the necessary tasks.

Besides the workstation hardware, Omninet requires a separate "utility server" to allow network users to share serial printers and one parallel printer in any combination. This server can be a PC or a separate hardware unit that functions as a network node. You install the server by connecting the printer to it in the same way you would connect it to an ordinary computer, and by attaching the server device to the network cabling. The installation package includes utilities for configuring the software that controls the server. Much of the network software at each station, loaded during boot-up, is the spooler interface with the utility server.

Printers connected to the XT server can be used only locally, not shared, so the XT cannot function as the utility server—an uncommon limitation. If a PC is used as the utility server, that computer becomes a

Besides the workstation hardware, Omninet requires a separate "utility server" to allow network users to share serial printers and one parallel printer in any combination.

dedicated print server for the duration of the print job.

Corvus sells a dedicated print-server device that acts as a go-between for the network and the shared print device. This unit is not the end-all link to shared printing, however. When using Corvus's native network software, the printer device cannot be connected to the server PC.

The workstation's spooling software supports direct output by applications such as BASIC programs (LPRINTs) or word processors, but only to a printer attached to

the workstation that is running the program; Omnishare doesn't permit routing direct output to a shared printer.

The spooler provides no means for finding out how long it will be before your file emerges from the shared printer. As the *System Manager's Guide* states, "Files are not necessarily printed in the same order as they are sent." Also, whatever its organizing principle, the print queue cannot be reordered to accommodate a high-priority job.

After you execute an Omnishare utility such as SPOOL, the system looks at drive A: (the floppy) for a copy of COMMAND.COM, and if it's not there, the system asks you to mount a diskette that contains it. This can be startling to the user, especially since it happens no matter what drive you are logged on to at the moment. Also, having to switch diskettes in the floppy drive is annoying. I wonder why this is necessary, since it does not normally happen when exiting DOS utilities.

Almost without exception, a selection from the workstation main menu leads into a hierarchy of submenus, and this can sometimes get confusing; you may begin to feel that Omnishare's designers have a passion for maze games. The solution is to consult the *Network Station User Guide*, which clearly explains the sequences of menus and allows you to peek ahead and see where the maze leads. Some tasks, such as printing, require that you enter more than one program, which seems like unnecessary wear and tear on the user.

Most menus offer a Help selection, which is to be expected. But the Help facility is the most inconsistent facet of the user interface. Occasionally, the "help" you get is the message NOT IMPLEMENTED YET. Also, some help screens tend toward the tautological, for example, "Remove volume—Remove a volume from a drive." Help like this is no help. In

other cases, however, the help screens contain better information than what is found in the manual.

Performance

The benchmarking team found itself in the midst of considerable difficulties testing the native operating system on this net-

work. The first attempt to run the "development environment" test on two stations progressed as far as the batch files' sign-on message, after which the system locked up, leaving the three-key reboot as the only alternative exit. The second attempt ran the development test acceptably—nothing blinding. Corvus took an consid-

erable dislike to the four-station version of the same test, based on the excessive number of "Read Fault Error" retries necessary to successfully complete this development test (see the benchmarking methodology article, "Benchmarks for Network Ratings," in this issue).

A significant number of "Read Fault"

Spooling Is Complex

Omnishare seems to suffer from writer's block; though the software works well and has good menus to guide you, you may need technical support.

A good example of Omnishare's tendency toward overcomplication is the print spooling. Although the shared-printer spooling software works well and has an outstanding series of menus to guide you through its intricacies, the several steps required to transform a file into printed copy make it awkward. First of all, you can spool only actual files that already exist on disk. To do this, you type the SPOOL command and select the "S" (Spool a File) option, then answer a series of questions posed by the utility. This transfers it to the "pipe," a server file that acts as a conduit for information in transit among network users and/or shared devices. Having completed the transfer, the user then exits from SPOOL. Next, it's necessary to tell the system to print the file by entering another utility called DESPOOL, answer yet more questions, and ultimately route the file—by explicitly naming it—from the pipe to the printer. This clumsy procedure turns the important but usually trivial task of producing page copy into a major project.

So, now that all the extraneous instal-

lation procedures are out of the way, you may be ready to begin spooling—but there is a very good chance you will not be able to do it! Here the documentation deserts you, making technical support calls inevitable, even for the most technically oriented networkers. This does not mean you are not given a good overview of the logistics behind PIPES (a good explanation is provided), or that spooling is difficult syntactically (SPOOL and DESPOOL utility menus are available, equipped with options for changing parameters). Nowhere is there any reference to how to install the printer, or how to properly run spool the way Corvus intended. To make a long story short, the results of several help sessions with Corvus via telephone filled the gap that created the spooling problems. Here's what I found out:

1. Installation creates a file called CONFIG.SYS that contains within it a device driver command, which causes DOS to load an automatic spooldriver at that workstation at boot time. The Constellation II system expects you to dedicate a user PC to be attached to the print-

er and act as the sole guardian of despooling. This dedicated despooler PC must not have the automatic spool driver. If it does, files despoiled from a pipe will return to the spooler instead of going to the printer. The way to keep this from happening is to use the DOS EDLIN command and remove from CONFIG.SYS the line that equates a device with SPLDRV.BIN. (This procedure is necessary only for the PC to be dedicated to the task of despooling.)

2. The automatic spool driver eliminates the need for spooling via the SPOOL utility. Issuing a simple PRINT command with the filename will accomplish the task. To have automatic spooling capability, the dedicated despooler must be running simultaneously in the foreground.

3. Once a pipe is despoiled, it is lost forever. Pipes are open during Read/Write processes, and closed otherwise. Pipes that have been forced open and do not find the end of the file must be closed or deleted under the Parameter Manager facility of the Manager's Utilities, posthaste.—K.P. and S.K.

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errors also arose during the "productivity" tests, particularly on the first workstation PC connected to the net. An average of eight retries were necessary to complete a test on this station as compared to the three or fewer errors occurring on the other PCs. This problem recurred in other tests, regardless of the task being performed.

As explained in "Benchmarks for Network Ratings," though, we considered retries to indicate not a network failure but an expected DOS response to "timing out" while waiting to be serviced by the network server's hard disk. The Corvus operating system likely could use a rewrite to provide more equitable servicing of station hard disk requests and/or a lengthening of the time-out parameter in their workstation DOS.

Overall, using its own operating system, Corvus did not perform impressively (even when we did get it to finish a test), clocking in with some of the slowest scores. On the bright side, booting up Novell NetWare on Corvus makes all the difference. The lack of significant problems, along with remarkable increases in speed (some tests ran almost twice as fast with NetWare) were astonishing. Corvus miraculously transformed from one of the turtle-slow nets to a rabbit-fast one. This example sends a clear message to the programmers: It's not a hardware problem—*rewrite your code.*

Because of Omninet's structure, any workstation can perform the installation of the network operating system as long as it has one double-sided floppy drive and at least 128K of memory. An installation manual describes the process, which entails several steps executed via a menu-driven utility. Reformatting the XT's hard disk is essential as the first step; this is performed from whatever node is doing the installation and does not require a physical visit to the XT. The reformatting is destructive, and so you have to make

sure you have backed up anything of value.

To its great credit, Corvus furnishes a preconfigured network of five workstations in the installation package. The menu-driven utility assumes you want to use this setup, and it prompts you accordingly by furnishing the defaults as answers to its questions; either you change them, or you press Enter to accept them.

The installation of standard configuration—assuming one avoids the pitfall of mount unit numbering—proceeds quite smoothly and rapidly, taking no longer than half an hour. It would take less time if the network management software were written more efficiently. It runs at an ago-

Blithely accepting Omnishare's defaults without checking the manual can lead to trouble in one case.

nizing pace and introduces long delays between phases of the process.

The first order of business for installing the hardware end of the Omnishare network is to set properly the device addresses on the transporter cards. The host station must be assigned the address 00H. The documentation does not explicitly clarify how to set up the switches. The eight-switch DIP is inversely configured; that is to say, a switch in the ON position is in truth a closed connection to ground, or a logical 0.

Transferring the software to fixed disk is easy to accomplish. Three disks provide the crucial CONFIG.SYS file and Pascal library files that run the System Manager

utilities, as well as other applications. The well-documented installation software is truly a snap to use. It requires approximately 12 to 15 minutes to complete, including the initial formatting of the hard disk itself.

Documentation and Support

The network manuals provided by Corvus consist of several specialized pamphlets in the now-familiar IBM size, contained in a ring binder. These are all typeset in two colors, with large print and abundant white space. Each manual begins by discussing documentation conventions, a helpful feature. Short sentences and simple language throughout make the text easy to read even for computer novices. The manuals do an excellent job of presenting procedural information. A cookbook approach leads the user from one numbered step to the next, with sample screen displays. The only shortcoming in the documentation is the lack of troubleshooting guidelines, a summary of error messages, and a glossary.

Documentation for entering the management utility is contained within the *Omnishare System Manager's Guide*, in Chapter 2, "A Sample Session." Blithely accepting Omnishare's defaults without checking the manual can lead to trouble in one case. This has to do with assigning numeric values to mount units. The mount-unit prompt for each new volume supplies the number 2, whereas in fact these numbers should be assigned sequentially (2, 3, 4, . . .).

As a test of the telephone support you might expect, I tried calling Corvus about a legitimate problem encountered during use of a feature called the Fixit facility. This program is not mentioned in the documentation, and so the only way a system manager can learn of the facility is to contact Corvus. That wasn't as easy as it may sound. After being passed around from

person to person a bit, I finally got an explanation.

As for manufacturer support when dealing with problems of installation, meeting building codes and FCC regulations, and the like, Corvus makes an effort to be helpful. A pamphlet called *Omninet Installers Tips* is available from Corvus's technical support group upon request, at no charge.

All Omnishare hardware is warranted for six months and, if found defective, may be returned to Corvus for an immediate exchange. Return shipping is paid by Corvus. In addition, Corvus now has more than 100 authorized service centers for repairs or exchanges. If having an on-site service contract puts you at ease, because you just can't afford to have your network be down for long, you'll be comforted to know that one is available from Corvus, through Decision Data.

Modest but Adequate

By and large, Omnishare is sound, and it works well, as indeed it should by this time. Aside from using a shared printer (see sidebar, "Print Spooling Is Complex"), little about life in this network can disconcert a newcomer accustomed to operating a standalone PC. For the most part, the things that are different while working in Omnishare are easy to adjust to. Omnet is not without its defects and difficulties, but as long as you do not push too hard against its modest goal of sharing a hard disk among a few PCs, it performs satisfactorily.

Its awkward print spooling and slow network management notwithstanding, Omnishare is a proven and settled product. The success of this network in the marketplace—regardless of the fact that it was there first—indicates that many customers require just what Omnishare has to offer: modest but adequate performance at a reasonable price. ■

Davong Multilink

As a middle-weight local area network, the Davong network system offers good token-passing service at a reasonable price.

Local area networks that are designed for the IBM PC can be divided into three broad categories. The simplest networks are peer systems, such as X-Net, in which every station is equal. The next step up is a middle-weight LAN, such as the Davong system. It uses a PC as a combination file server/workstation and can do serious work in a heavy-duty environment, but it has to work hard to carry extremely heavy loads. Extra heavy-duty systems use a dedicated network controller with a 68000 microprocessor.

The Davong network provides an excellent mix of capability and price. Any station in the network can use the resources of any other station on the network. Davong does not use specialized hardware as a file server, so you must have at least one PC on the network that has a hard disk to work as a file server and network controller. This hard disk PC can serve the network and act as a normal workstation at the same time, so you don't lose the use of the PC while it's controlling the network.

Network Features

Multilink, Davong's network software package, includes a module called

SHRDSOS that does the work of file locking that prevents the corruption of files by ensuring that more than one user cannot change a file at one time. This file-locking scheme is much faster and more efficient than complex record-locking programs, but note that single-user access may not be sufficient for applications where many users need to read or update one database at the same time.

Once you invoke SHRDSOS, it keeps track of all file actions on the network. For instance, if a file is opened for read/write operation, SHRDSOS places a lock on this file until the user who opened it closes it. If another person attempts to access that file, Multilink sends a message that says the file is in use by a specific operator and provides the familiar abort, ignore, and retry alternatives.

An interesting and unique Multilink command, called PACE, regulates the number of network packets the file-server PC will process in a given time frame. Packets are bundles of information sent to and received from user stations in the network. Packet processing takes a significant amount of time from the CPU of the PC that is working as the network controller. Therefore, a tradeoff occurs between

Peter Feldman and Frank J. Derfler, Jr.

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the use of this PC by an individual user and its use by the network. You can use the PACE command to adjust the balance between the network and an individual user. This pacing function monitors the activity of the file-server PC by monitoring when the last keystroke was read from the server's keyboard. If the keyboard is inactive, the PACE module allows more time for packet processing.

Standard MS-DOS programs such as *WordStar* work well over the Davong network. *Multilink* uses subdirectories and pathnames to route requests for files. *WordStar* can't access its text files through pathnames, but if the *WordStar* data and program files are in the same subdirectory, you can run the program from any machine in the network. If two users try to open the same text file in *WordStar*, *Multilink* sends an error message to the second user that says the requested file is in use. Less capable network operating systems from other manufacturers hide the text files that are in use from such programs as *WordStar* and present you with the frustrating experience of not being able to find a file that should be available. The Davong software does a good job of keeping the users on the network informed with clear status messages.

Framework works well on the Davong network, but it is confused by the fact that Davong accesses the network through DOS by calling the network drive Z:. As a result, *Framework* shows a list of ten available drives on its "desktop," while in fact fewer drives exist. When a drive that doesn't really exist is selected, a "Drive not ready" error message appears on the screen. The *Framework* system is not designed for multiple use in a network application and the copy-protection scheme forces you to have the master system *Framework* disk in one of the local floppy drives.

The Davong network system uses a

token-passing access scheme that it shares with the ARCnet systems that are marketed by Datapoint and Tandy Corporation. IBM announced its plans to use token passing as an access scheme in a LAN product to be released in the future. And Big Blue has also announced a ring net-

work topology that is shaped like a multi-leaved clover. The ring is pinched together in such a way that if portions of the ring are disrupted, they can be patched around. The Davong system is arranged in a similar, but not identical, manner that provides resistance to interruption. The topol-

LAN FACT FILE: DAVONG MULTILINK

Marketed by:

Davong Systems
217 Humboldt Ct.
Sunnyvale, CA 94089
(408) 734-4900

Retail Prices

Starter Kit	\$ 2,395
Workstation	\$ 700
Server Station	\$ 2,645
Dedicated Server	N/A
Cable (per foot)	N/A
Connector	\$ 100
Repeater	\$ 800
Four-Station Configuration	\$ 7,490

Hardware Capabilities

Configurations:

No. Servers	1-255
No. Workstations	1-255
Server Type	XT

Memory Min./Max.

Dedicated Server	N/A
XT Server	192/640K
Workstation	192/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Tape	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Ring
Type	Baseband
Speed	2.5 Mbits/sec.
Server Type	XT

Security

Login ID	<input type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input type="checkbox"/>
Record Protection	<input type="checkbox"/>

Diagnostics

Cable	<input type="checkbox"/>
Server	<input type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input checked="" type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input checked="" type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

ogy of the network is referred to as a "distributed star burst." This star arrangement is built around hubs that function as the connection point of stations to the network.

System Hardware

The Davong network hardware consists of interconnection cards in every PC on the network, coaxial cable, and hubbing devices that connect stations into the network.

The Davong network has two types of hubs. The Davong Hub4 is a passive connection that does not amplify the network signal. The Davong Hub8, an active device, amplifies the signal and can handle longer cable runs than the Hub4. The two devices can be connected to each other to make a large network with up to 255 stations and 20,000 feet of cable.

In the simplest network arrangement, the Davong system could be set up with two stations. In this case, there would be no need for a hub unit. When the network is expanded to three stations, the Hub4 unit is needed. The fourth port on the Hub4 can be connected to a Hub8 to extend the system. However, two Hub4 devices cannot be connected together because they do not amplify the signal and it can become too weak to use. From this point, more workstations and hubs can be added to expand the network. This method of expansion limits the initial investment you have to make and allows the network to grow in affordable steps.

Davong claims its hardware will work

with PC clones manufactured by Columbia, Compaq, AT&T, and ITT. But because of a difference in the expansion bus, it excluded the Eagle 1600 system. The company also claims that network

A LAN's ability to control multiple requests for printer output is a good measure of its usefulness to you.

servers and workstations from Nestar, Datapoint, and Standard Microsystems can be connected to the Davong *Multilink*.

System Software

Davong sells PROMs that allow each system on the network to operate without the need to boot from a floppy disk. This simplifies operation and somewhat reduces the need for operator training.

Network administrators find they need security in almost all kinds of corporate systems. In fact, if everyone on the network can freely access every file, the potential for sabotage or fraud becomes high. *Multilink* provides up to four levels

of network security that can be set to require up to two passwords and two user names for access to certain network functions. In addition, you can give password protection to each volume on the hard disk.

Under *Multilink*, the operation of the disk server is improved by using disk caching. Frequently used data is held in a special RAM buffer so it can be quickly retrieved.

Access to a printer or printers is important in almost every business and computing environment. The ability of a LAN to control multiple requests for printer output from several workstations—sometimes to several printers of different types—is a good measure of its usefulness in the business environment. In order to manage printers and requests for printed copies from several users on the network, the printer control software must be able to designate an order of priority for printer access and sort out requests for work among different users and printers.

Davong provides a utility, called PRNSAVE, that captures and holds any characters sent to the printer port of a specified PC. If you run typical DOS or BASIC programs that send data to a printer, the data is captured in a specially named file. You can then send this file across the network into Davong's printspooling and management software by typing PRINT and the filename. It is unfortunate that Davong chose to name its PRINT command with the same name as the normal PRINT command in DOS; this can lead to confusion over where the printout is going to appear.

When you type the Davong PRINT command, it closes the print buffer (DOS pipe), so if you have any further output you have to re-enter the PRNSAVE command to restart the process. The new pipe will not retain any of the material in the previous one. Unless you back up the

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Database
Davong Multilink	632	108	98
Davong Novell	367	106	75

NETWORK SURVEY

PRINT file before you type the command, the file disappears once it has been committed to paper.

Performance

Token-passing schemes that are based on the ARCnet model have one inherent weakness: each packet that moves information around the network has a maximum size limitation of 508 bytes. When a message exceeds this limit, the software breaks it into 508-byte (or smaller) pieces. The network software knows how to put the packets together again when they arrive at their destination, but a large message can be delayed because it may have to wait for a final packet that has just a few bytes. Moreover, if the network is heavily loaded, large messages can delay each other because the token will be filled by alternating stations as it goes around the ring. No message has priority, and all messages are equally slowed. To avoid this potential problem, you can arrange any applications software you use on the network so it sends messages of less than 508 bytes.

In addition, we found that a 10 to 15 percent decrease takes place in the I/O speed of the hard disk when the file-sharing SHAREDOS module is running. This decrease occurs because every read and write action to the hard disk travels through additional operating system levels that examine the level and status of the file it asks to use.

Installing Davong

The most important part about installing the Davong network is planning the physical configuration. The hubs allow good flexibility, but you have to plan how to use this flexibility. You should make diagrams showing the location of the hubs, the length of the cable runs, and the location of the network stations. Good planning is essential because Davong uses a coaxial cable medium that is more expen-

sive and difficult to install and move than twisted-pair wiring. Also, because of the configuration of the hubs, you can't just run a continuous length of cable to every potential workstation location as you can

The most important part about installing the Davong network is planning the physical configuration.

with a bus or true ring system. The time you spend planning the geography of a Davong network is well invested.

The physical installation of the boards in the network PCs is very simple. A red LED on the circuit board is supposed to be used for trouble shooting, but it wasn't very useful because the documentation didn't explain what the light was monitoring or give examples of malfunctioning symptoms.

It seems that no other product you can buy for a PC has as much potential for electrical conflict with other add-on boards in a PC system as a LAN interface board. In almost all of the systems we tested at *PC Magazine*, including the Davong, we found it was very important to check for conflict with both the direct memory addressing system and the interrupt calls. Many different kinds of video, memory, I/O, and disk controller boards can conflict with the network interface boards. If you have a problem, you may have to remove all of the boards from the PC beyond the bare minimum and then add them back one at a time until you find the conflict. If there's a serious conflict, you may have to replace an expansion card.

The installation of the rest of the Davong network hardware involves working with coaxial cable and connectors. This mechanical work isn't too difficult, but you have to be careful to ensure good connections without shorts or grounds. This may sound like simple advice, but, in a ring network, it is particularly important because if any one connection is bad, then the whole ring is bad.

The procedure for installing the software starts with booting DOS. After this is done, the manual instructs you to copy the network operating system programs from the master disk. A Davong installation utility performs a quick installation of operating systems set for general operation. On the other hand, if you want to configure or name the hard disk system in some unique way or make other customized changes to the software, such as turning off automatic testing functions, you have to go through a lengthy and complicated "manual" software installation.

Documentation

The Davong documentation is good. Davong provides both operation and installation manuals, and each manual has illustrations, a table of contents, and an index. They have trouble-shooting guides and even include glossaries. The manuals are also easy to read and very well organized. Moreover, they are printed in big type on high-quality paper and come in their own attractive hardcover book cases. Many modern PC programs and products don't need detailed manuals, but local area networks still do. Good manuals can significantly reduce the amount of work involved in installing and using local networks. The Davong manuals help a great deal.

Maintenance for Davong systems is available from RCA and Sorbus. RCA does on-site service, but Sorbus provides only carry-in maintenance. ■

Nestar PLAN 3000

For large networks with heavy loads, the Nestar PLAN 3000 system offers speed and power—and that means complexity.

The Nestar PLAN 3000 networking system is truly impressive. Called PLAN, for Personal Local Area Networking, it is fast and extremely powerful, in many ways resembling a mainframe environment. With dedicated file servers of up to 56 megabytes of capacity each, it can network as many as 255 stations. It can also share hard disks at workstations as secondary file servers, as well as other resources on the system.

Unlike most networking systems, PLAN had been designed primarily for larger networks in the 30- to 200-workstation range. According to Nestar, networks of somewhere between 80 and 120 stations are more typical. For networks of fewer than 30, the cost per station may be a drawback.

Group Authorship

One of the most interesting features of the PLAN 3000 network is the way it appears to permit several users to update files simultaneously. Obviously, only one station can be allowed to write to a file at any given moment. But with "token-passing," the system allows several stations momentary access, on a rotating basis, to dump updating data to the file server(s). In essence, the token is a small group of bits

passed around the network from station to station.

If you have six operators updating the same file, all may have new data to send, but only the workstation that has the token is allowed to do so. After that station has dumped a quick burst of data to the file server, it is obliged to pass the token on.

Token-passing is generally slower for small, lightly loaded networks than more conventional collision-sensing schemes are. But with token-passing, the throughput rate is almost constant even with a fairly heavily loaded net. So for a larger, more heavily loaded network such as you might expect with a PLAN 3000 hookup, token-passing can result in a higher throughput.

Of course, even with this form of multi-user write access, read-only access by other users might be desirable. That can be managed by means of different password levels. And since the data is never actually resident anywhere except the central server, all updating is reflected immediately in the data all stations are reading.

Network Structure

Nestar calls the network architecture an "arbitrary tree," and the term is quite appropriate. Imagine a file server at the base with a line, a trunk as it were, running upward from it. At some point, a "hub" intersects the trunk and branches out in different directions; these branches in turn split off at other hubs to form new sets of branches. And these in turn can split further at other hubs. The structure of the branches need not be symmetrical, nor does the same combination of equipment need to be attached to each—thus the term "arbitrary."

In theory, a PLAN 3000 network could contain something like 65,000 of these hubs. It doesn't because there are "passive" hubs and "active" hubs. Just as you would expect, a passive hub is nothing more than a branching-off device; where workstations are physically fairly close together, a passive hub is quite satisfactory. However, if the distance between stations is more than 2,000 feet (5,000 feet with fiber optic cabling), a repeater of some sort is required, and that is what an active hub is—in addition to being a point at which the net can branch further. Through the use of active hubs as repeaters, the maximum distance between workstations can be increased to something like 22,000 feet, according to Nestar. Many of the theoretical 65,000 hubs would be repeaters with no workstations attached.

Physical installation of PLAN 3000 networking at the workstation level is simply a matter of putting a Nestar networking interface board into an empty PC expansion slot.

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
Nestar PLAN 3000	383	104	103

Jim Forney

sion slot and plugging in the cable.

There would seem to be few applications within the practical limitations of networking that the PLAN 3000 can't accommodate, considering that dedicated file servers are offered that range in formatted storage capacity from 15 to 56 megabytes each. The PLAN 3000 file servers move 2½ million bits per second. And file dumping between the server(s) and the 60-megabyte streaming tape backup is accomplished at a rate of 1 megabyte every 11 seconds.

Physical drives and RAMdisks at a workstation retain their usual designations, except that the PLAN network boots on virtual C:, which displaces a physical C: up one notch, to D:. All of the virtual volumes from the file server(s) are then mounted on virtual drives, typically E: through Z:.

Mass storage is not limited to dedicated file servers, however. Any hard disk on the system—an XT or AT, for instance—can be a shared network resource.

Because of the way the elements of this Nestar system are interconnected, individual user workstations can be booted onto the network or shut down at any time, even while the one or more file servers on which they depend are on-line and available, without affecting network operations. This capability means that, unlike on some lesser systems, various and assorted users can wander in and out pretty much at leisure. And the stations don't even have to go through a formal logging-in process to be recognized and accepted by the network (except where passwords are required for access to specific data).

This lack of formality doesn't mean that anyone with access to an open port can quietly come on-line and "listen in" unnoticed. Any active user can issue a SHOW STATIONS command to get a listing of all stations on the net at any given time. While I was reviewing the network,

Mainframes on the LANscape

The LAN-to-mainframe connection is limited by product scarcity, but the near future promises new products and more flexibility.

Hooking up PCs with a local area network isn't enough if the data you need to work with is on a mainframe. Whether the big machine is a resource belonging to your own organization or a publicly accessible service, network-to-mainframe communication can put megabytes of information at more than one set of fingertips. As with any other LAN application, a LAN-to-mainframe link is usually motivated by a desire to share expensive resources and to make data more freely accessible. Minimizing costs means sharing the hardware needed to communicate with a big machine, whereas facilitating information exchange means configuring the network so each user appears to have exclusive use of the connection.

Fortunately, most mainframes use an IBM-developed protocol that had already been designed to support groups of workstations operating in clusters. This communications system, which most people refer to as "3270," is part of IBM's massive Systems Network Architecture (SNA). With 3270 communications, a mainframe (or its communica-

tions processor) communicates by cable or modem to a controller, and the controller talks to groups of terminals. One approach from the network end, consequently, is to configure a machine on the network to act like a controller to the mainframe but act like a communications server to the network. As a 3274 controller, the connection links up with the mainframe using IBM's SDLC synchronous communication protocol, assembling and receiving messages for workstations on the LAN. As a network server, it takes messages from the mainframes, adds the required routing information, and sends them out over the LAN. Going the other way, the server listens on the network for messages marked for the communications link, formats them into the form expected by the mainframe, and sends them out, acting as a controller.

The protocol converters designed to let standalone PCs communicate with mainframes don't work on existing PC networks because the protocol converter is not a resource the network knows how to manage. Without code to tell the network how to pass messages back and forth to the converter and what to do if

Steve Rosenthal

two users both want the resource, the networks can't make use of the link. You can, in most cases, still use a protocol converter on a workstation, allowing only that machine to be used for communications with the mainframe. In addition, you may have to re-address either the network cards or the protocol converter, which may default to the same interrupt or port locations. Although networks don't yet provide protocol converter-sharing capability, firms that specialize in communications products are now beginning to take up the slack.

You may soon choose to equip your LAN also with a "session server." In the mainframe world, each link-up between the mainframe and a user terminal is called a "session," with many mainframe software systems allowing users to start up and switch between several sessions running at one time. One of the first session servers for PC-based LANs is Techland Systems's BlueLynx Gateway, which allows you to distribute sessions among the network workstations, running one session from each workstation or several sessions from a single workstation. Corvus also has a session server that it's comarketing with Systems Center. Novell's new session server, developed by Pathway Design, seems equivalent to Techland's.

According to Charles Morell of CXI, Inc., of Palo Alto, California, some changes in IBM design philosophy for 3270 devices should help make sharing a network connection easier. IBM, he says, has switched from treating all 3270-series terminals as dumb controllers to the Device Cluster Attachment philosophy, which puts most of the intelligence in the device and little of it in the network controller. This should also

make it easier for firms like CXI, which manufactures micro-to-mainframe telecommunications products, to come out with various intelligent mainframe links for the PC. One key issue, Morell points out, is to make a good division between presentation services at each workstation (for formatting the display) and the communications services required to maintain the link.

More to Life than SNA

In addition to the SNA links used by most IBM mainframes, some big mainframes and most minicomputers support asynchronous communication as their protocol for talking with both terminal and remote systems. This is also the method used for PC-to-PC communication, especially through modems over phone lines. Sharing asynchronous communications capability would mean sharing serial ports or modems, which current PC networks are not set up to do. PC owners are presently limited to systems that either require one modem per PC or use switching arrangements to share a modem between standalone systems.

Another increasingly important LAN connection is on the drawing board. The term X.25 denotes a series of communications protocols for sending messages in the form of packets. X.25 gateways for PC LANs are apparently in the works but not generally available.

Eventually, connecting a LAN to a mainframe may be as simple as running a wire between two tin cans. The current state of the art is clearly way behind that, but progress is being made. LANs and mainframes that are hardly on speaking terms may soon be engaged in a perpetual dialogue. ■

the command proved to be a vital diagnostic tool, if a rather loose sort of security.

Net Interface Program

Nestar claims the dedicated PLAN system, operating under DOS 2.x, can address a maximum of from 273 to more than 500 drives simultaneously, with that maximum depending on how many stations have the same virtual volumes mounted simultaneously. Any given workstation can mount up to 26 drives at any one time, and all 26 can be virtual drives. Drives can be designated by numbers or by any letter from A through Z.

To address these drives and manage the network, you use Nestar's *Net* interface program, which runs under many different operating environments. When you boot any workstation on the network, the *Net* software appears as if mounted on virtual drive C:, although it never actually leaves the file server.

Many commands in *Net* are identical to those in DOS or BASIC. But even with the familiar-sounding commands, there are differences. *Net*, for instance, doesn't recognize abbreviated commands like *REN* or *DEL*. Interestingly, you can access these *Net* functions from within DOS without actually entering the *Net* system by typing *NET* as a command prefix.

Secured Access

PLAN 3000 offers three levels of controlled access to its virtual disks: public, group, and private. Access levels are determined by the use of passwords. Typically, the public level would require no password at all, but since you wouldn't want just anyone writing to files, such public access could be limited to read-only. A select group could be given a group password that would allow read/write privileges for updating files. However, the group could be denied the right to create, erase, or delete files. Those abil-

NETWORK SURVEY

ties could be reserved for people with the private password.

If a password is misplaced somehow, you have a problem; PLAN 3000 has no provision for bypassing the protection, and the password can't be recovered even by

dumping the disk. All is not necessarily lost, however, for the console that controls the network allows certain "super user" privileges, among which is a means of putting in a new password.

Software locks are another mechanism

for controlling access to shared resources in the system. Here again, there is a whole set of protocols. Locks may require passwords to unlock them and can limit the maximum number of users allowed simultaneous access to any resource.

Print Servers

Any PC, even one without any physical drive, can be configured as a print server for up to two shared printers (one serial and one parallel). Requests for printing from any workstation on the network can be addressed to a specific print server if there is more than one on the network.

However, if you have no reason to specify a particular printer or server, you can send your print request addressed to "any" print server and it will be directed to the first available printer on the network. Waiting requests are normally queued and printed in the order in which requests are received. However, requests can be assigned priority codes.

While any PC workstation can be designated as a print server, when it is serving a printer it can perform no other function. In fact, even a designated print server boots up as an ordinary workstation and cannot be accessed for printing until someone pushes the appropriate menu responses to release it for print serving. So, in choosing which PCs are going to double as print servers, some care must be taken to select units that are not heavily used as workstations.

The Bundle

Several software packages come with the PLAN 3000 as standard issue. These include a word processor with spelling checker, electronic mail, a spreadsheet, an accounting program with provisions for handling receivables, inventory control software, and a multi-user database.

There are several pop-up menus in the Nestar system to get you past the initial

LAN FACT FILE: PLAN 3000

Marketed by:

Nestar Systems Inc.
2585 E. Bayshore Rd.
Palo Alto, CA 94303
(415) 493-2223

Retail Prices

Starter Kit	N/A
Workstation	\$ 600
Server Station	N/A
Dedicated Server	\$12,995
Cable (per foot)	20¢
Connector	N/A
Repeater	\$ 595 (6 ports)
	\$ 1,095 (16 ports)
Four-Station Configuration	\$15,990

Hardware Capabilities

Configurations:

No. Servers	1-254
No. Workstations	1-254
Server Type	Dedicated
Memory Min./Max.	
Dedicated Server	256/256K
XT Server	N/A
Workstation	128/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Tape	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Arbitrary Tree
Type	Baseband
Speed	2.56 Mbits/sec.
Server Type	Dedicated

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

startup operations. In fact, the menus that are provided can not only handle boot chores but get you started in any of several applications packages that are included. Now, I may have some slight edge when it comes to working with unfamiliar software packages, but I had so little difficulty in getting any of them up and running that it appears it would not take much special training to get people started.

In addition to the packages that come with the system, several other multi-user software licenses are available from Nestar. These include *NDBS 3*, *dBASE II*, *Revelation*, *PC Focus*, and *B-trieve*. And, according to Nestar, any other software that can be run from a hard disk can be used with the PLAN 3000.

No prepackaged business system can anticipate all the peculiarities of any particular real-life business environment. And looking at this package, I saw things that could be improved. But certainly the PLAN 3000 package comes with some very professional tools, ready to set up and go to work with.

Conclusion

The bottom line is that the Nestar PLAN 3000 is an impressive system. It's designed for serious networking on a grand scale and designed with the flexibility to grow and keep pace with a changing work environment. However, as impressive as this system is, one serious question has to be addressed by anyone considering implementing a network this large.

How much standalone processing do you anticipate—or need—at the workstation level? If your answer is “not much,” then a true mainframe with dumb terminals may be a better choice for you from several points of view. However, if a lot of people have to do a lot of standalone work while processing megabytes of library files, you should give the Nestar PLAN 3000 serious consideration. ■

Novell NetWare/S

You'll need time and experience to get this network going, but the reward is one of the best LANs available.

The Novell NetWare/S network is a hardware extension to PCs and a software extension to PC-DOS that gives multiple users access to a central fixed disk and printers. When your boss drops by an hour after it has arrived and asks “Get it running yet?” give him or her a look that would tell anyone to stay away for a week. Take it slowly and carefully—there's lots to learn. You'll have a head start if you're familiar with technical PC-DOS materials and have done some exploring on your own. A good working knowledge of sub-directories and search paths is also important.

Don't expect the network to be easy to set up and use, don't expect it to solve all your problems, and don't expect it to slip into your current array of PCs without some getting used to. But put it to work, and you'll have one of the best PC networks available—a good, powerful system with a hefty fixed disk and potential for expansion.

There will be some training ahead. More than 40 new commands come with the NetWare software. Unless the PC workstations are set up so that users don't have to use PC-DOS much, these new network commands will be used as often as

existing PC-DOS commands are.

Applications

The Novell NetWare/S network system (the *S* stands for Star topology) can handle up to 24 PC workstations. Each workstation has access to a centrally located hard disk and printers, without losing any of the power or the facilities of the standalone PCs. Network users may share files on the hard disk, route a document for printing, send messages and mail, and even play the multi-user *SNIPES* game, included for “fun and entertainment for users of the NetWare system.”

In everyday use you will boot PC-DOS in the usual manner from a PC workstation. At that point you'll be able to use the PC as you usually do. To gain access to the network, you run the program *NET20S* or *NET11S*, depending on the DOS version. (The program can be in an *AUTOEXEC.BAT* file to be run when booting.) You'll then have access to the shared hard disk, but with only one subdirectory, called *LOGIN*, containing just one program, also called *LOGIN*.

Type *LOGIN*, your user name, and your password, and you're in. It will then appear as if your PC has acquired another disk drive. A PC workstation with two diskette drives will have personal access to

Charles Petzold

NETWORK SURVEY

drives A: and B: on the PC and shared access on drive C:. Any programs you run may treat this new drive as if it were just another drive on your machine. Programs still run in the workstation's PC memory, but the programs may be loaded from the shared disk, and they may use and save files on the shared disk.

The files on the shared hard disk will be scattered among hierarchical subdirectories. On a PC-XT subdirectories are often just a convenience; on NetWare/S they are an integral part of the network design, the basis for user allocation of space, and the security of the system. One subdirectory will be called PUBLIC and will contain most of the NetWare/S commands. Another will be called SUPER and will be inaccessible to everyone but the system supervisor. Each user will also have his or her personal subdirectories defined by the NetWare/S supervisor when establishing user IDs.

The system can also think of subdirectories on the shared hard disk as additional disk drives. Users may set additional drive letters to stand for subdirectory paths. For instance, a drive E: can be "created" by a user to refer to the directory path MYDIR\LETTERS. This is accomplished by using the NPATH command with the syntax

NPATH E: =SYS:MYDIR\LETTERS

This aliasing of drive letters to a directory path is a good shorthand way of changing subdirectories. You don't enter CHDIR\MYDIR\LETTERS; you just change the drive to E:. It's more powerful than that, though. While many programs cannot be directed to retrieve and save files in a particular subdirectory, they can almost always use a particular disk drive. So if you tell your word processing program to use drive E: for your documents, NetWare/S will actually use MYDIR\LETTERS.

Other make-believe disk drives are created when you set search paths with the NPATH command, which looks something like

NPATH SEARCH2:
=SYS:MYDIR\FORMLETTERS

Like the PC-DOS PATH command, NPATH orders a search of the indicated subdirectory if a requested file is not in the current subdirectory. However, the PATH command only affects the loading of programs. NetWare/S will conduct a search

LAN FACT FILE: NETWARE/S

Marketed by:		Network Description	
Novell, Inc.		Architecture	Star
1170 North Industrial Park Dr.		Type	Baseband
Orem, UT 84057		Speed (max./min.)	300/600 Mbts/sec.
(800) 453-1267		Server Type	Dedicated
(801) 226-8202		Security	
Retail Prices		Logon ID	<input checked="" type="checkbox"/>
Starter Kit	\$15,595	File Passwords	<input checked="" type="checkbox"/>
Workstation	\$ 250 + \$1,995	File Protection	<input checked="" type="checkbox"/>
	for every six stations	Record Protection	<input checked="" type="checkbox"/>
	after the first six	Diagnostics	
Cable (per foot)	\$ 1	Cable	<input checked="" type="checkbox"/>
Connector	included	Server	<input checked="" type="checkbox"/>
Repeater	N/A	Workstation	<input type="checkbox"/>
Four-Station Configuration	\$15,595	Network/Station	<input type="checkbox"/>
		Auto Reroute	<input type="checkbox"/>
Hardware Capabilities		Software Capabilities	
Configurations:		Operating System:	
No. Servers	1	Disk Caching	<input checked="" type="checkbox"/>
No. Workstations	1-24	RAMdisk Support	<input checked="" type="checkbox"/>
Server Type	Dedicated	System Management	<input checked="" type="checkbox"/>
Memory Min./Max.		Others	<input checked="" type="checkbox"/>
Dedicated Server	512K/2 MB	Applications:	
XT Server	N/A	Electronic Mail	<input checked="" type="checkbox"/>
Workstation	64/640K	Chat	<input checked="" type="checkbox"/>
Shared Peripherals Available:		Utilities	<input checked="" type="checkbox"/>
Serial Printers	<input checked="" type="checkbox"/>	RAMdisk	<input checked="" type="checkbox"/>
Parallel Printers	<input type="checkbox"/>	Other	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>	Print Spooler Features:	
Hard Disk	<input checked="" type="checkbox"/>	Variable Buffer	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>	Disk-based	<input type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>	Change Paper	<input type="checkbox"/>
Modems	<input checked="" type="checkbox"/>	Unjam	<input type="checkbox"/>
RAMdisks	<input type="checkbox"/>	Printer Commands	<input checked="" type="checkbox"/>
Other Communications	<input type="checkbox"/>	Multiple Copies	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>	Queue Inquiry	<input checked="" type="checkbox"/>
Backup		Queue Reorganization	<input checked="" type="checkbox"/>
Vendor-Supplied	<input type="checkbox"/>	Purge Queue	<input checked="" type="checkbox"/>
Tape	<input checked="" type="checkbox"/>		
Global?	<input type="checkbox"/>		

any time a file is read. Again, if you're in a word processing program and want to use one of your standard form letters to answer a consumer complaint, for example, the word processing program will still think it's using drive E:, which NetWare knows is MYDIR\LETTERS. But NetWare will also search MYDIR\FORMLETTERS if the file can't be found in MYDIR\LETTERS.

Search paths are assigned drive letters starting from Z: and working backward. Drive Z: will usually be set at logon to be the subdirectory SYS:PUBLIC, which contains all the user NetWare programs.

So you can end up with a total of 26 disk drives, the first two or three letters being the real disk drives in your PC workstation, the others being aliases for various subdirectories of the shared hard disk. (If you can manage this arrangement without getting confused, NetWare will allow it.)

The aliases can be different for every user on the system. You can customize them for each user and set them at logon. Logon messages can also be customized. You use the wonderful but disappointing SETLOGIN command to accomplish this. SETLOGIN is wonderful because it can do some rudimentary logic with predefined operators like

IF DAY _OF_ WEEK IS "MONDAY"
THEN WRITE "AAARGH . . ."

(an actual example from the manual) and even make sounds with the FIRE PHASERS command. It's disappointing because it crashed PCs. (A Novell technical representative was very surprised to hear this and suggested that we were dealing with a damaged copy of this particular program.)

Sending messages is easy; you use SEND, the message in quotes, and then the user's name. The message appears at the bottom of the recipient's screen. But sending mail is another matter—you need



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NETWORK SURVEY

Novell's MAIL package, sold separately and not evaluated here.

You can use a shared printer from a workstation in two ways. If an existing file is to be printed, the NPRINT command works similarly to the PC-DOS 2.0 (and above) PRINT command. You place the file on the system's print queue. For printing from within a word processing program, you use the SPOOL command before entering the program. The server then directs all print output from the workstation to a temporary file on the shared hard disk. When you enter the END-SPOOL command, the file is closed and placed on the print queue.

Hardware

The Novell NetWare/S system is a star configuration. The stars of the show are the Novell file server and its companion hard disk subsystem. The file server is a box about twice the size of an IBM PC system unit. This box contains a 68000-based computer and one T1 99105 microprocessor for every two workstations. The file server has just one push-button switch on front, a reset button with an elbow-resistant plastic cover. The back panel is a whole array of cable jacks and cutouts for additional cable jacks. This setup isn't surprising since everything used in the system is connected by cable to the file server.

The hard disk subsystem must be located within 3 feet of the file server, most conveniently right on top of it. The configuration I tested came with a 64-megabyte Novell hard disk, but you can chain more hard disks to expand total capacity to a comfortable 320 megabytes.

Any shared printers or plotters must be within 50 feet of the file server. The file server will support up to five printers, but there's a serious catch: They all must have serial interface ports. The printer cable is standard RS-232.

Also within 50 feet of the file server

must be a dumb terminal to serve as the system console. You can use a PC, but it will require asynchronous communications hardware and software, preferably a package that can emulate a TeleVideo 925 terminal.

You can use the system console to monitor the whole system, reorder print queues, broadcast messages, and—when

You can use the system console to monitor the whole system, reorder print queues, broadcast messages, and even log users off the system entirely.

the system is acting particularly nasty—log users off the system entirely. The commands available on the system console and those available on a workstation are separate and distinct from each other. The system supervisor also requires a PC workstation in addition to the system console. All security restrictions of subdirectories use workstation commands rather than system console commands.

The workstations themselves are IBM

PCs with at least 64K memory (128K is recommended) with or without their own disk drives, hard disks, or other peripherals. Each of the PC workstations must have a Novell network interface card. You can boot a PC without disk drives from a ROM chip on the Novell board. Up to 24 workstations can be connected to the file server, each with its own dedicated dual twisted-pair cable. These cables may be 3,000 feet long.

To allow for the widest spread of PC workstations, you should locate the file server in the center. In the maximum configuration the file server will have 31 cables hanging out the back. So put it where the least traffic occurs or on a raised floor.

System Software

At least one person must supervise the system. Supervising mostly involves coordination and security, normally not a full-time job. The supervisor must ensure that each user has access to every subdirectory needed for his or her work, but no more. Most of the supervisory work can be done from any PC workstation attached to the network. The supervisor will be the only person who has access to the subdirectory SUPER and any commands in it.

The command most important to security is GRANT, which has a wonderful English-like syntax. For instance, entering the command

```
GRANT NO RIGHTS FOR  
SYS:CHARLES TO USER JOHN
```

keeps all my files in the CHARLES sub-

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
Novell NetWare/S	345	104	82

directory safe from the mischievous John Dickinson. He can change his directory to mine, but he can't even tell what files are there, let alone delete any. But if he also gets a copy of the GRANT program and enters

GRANT ALL RIGHTS FOR
SYS:CHARLES TO USER JOHND

I better hope I made a backup.

Yes, JOHND can GRANT himself all rights to files in my subdirectory. Although Novell put the GRANT command in the PUBLIC subdirectory, it really belongs *only* in the supervisor's SUPER subdirectory. The supervisor's password should be known only by the supervisor and a backup. The supervisor should control all the GRANTs and should GRANT *no* rights to the SUPER subdirectory for other users.

Besides the commands available on the PC workstations, a dozen network monitor commands can be run only from the system console. For instance, from the workstation you can send a file to be printed, look at the printer queue, and cancel any of your own print jobs. However, only from the system console can you reorder the queue, remove other users' print jobs, reroute printer output from one printer to another, hold up printing temporarily (to change paper, for instance), or cancel all print jobs entirely.

The system console also has a MONITOR command, which will display the percentage use of the system, transmission errors (if any), and status information on any six attached workstations at one time, including any hard disk files that are locked or in use.

Performance

Anyone who knows PC-DOS will not be surprised to see this network—any network—do some funny (or not so funny) things sometimes. PC-DOS is not a multi-



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NETWORK SURVEY

user operating system and is certainly not free of bugs. Neither is NetWare/S bug-free. Most programs that run under PC-DOS do not follow DOS rules; IBM and Microsoft, for example, frequently break their own rules. When a software shell sits between your applications programs and PC-DOS and allows you to share a central disk, it's bound to create problems.

In my first tests of NetWare/S the PCs crashed, and I had to reboot on several occasions. Usually the other PCs on the network were not affected, however, and only once did the entire system crash.

An initial problem I encountered involved exiting programs that wiped out the "transient" part of COMMAND.COM; this happens quite often with most large programs. When it occurs, PC-DOS attempts to reload COMMAND using the COMSPEC parameter. But the NetWare software had changed that parameter to C:COMMAND.COM, without telling me during hard disk initialization that I must copy COMMAND.COM to the hard disk. Since COMMAND.COM could not be found on the hard disk, I had to reboot.

My first solution was to reset the COMSPEC back to A:COMMAND.COM and reload a second copy COMMAND.COM to recognize the new COMSPEC. At first glance, this little trick seemed to work fine, but further investigation showed that I could not then set additional search paths. (The NetWare software was probably still using the earlier environment area, while PC-DOS was using the altered environment.) The simpler solution was to copy COMMAND.COM to the PUBLIC subdirectory of the hard disk. But this solution would not work if some workstations were running PC-DOS 2.0 and others 3.0, because each uses different versions of the COMMAND.COM file. If you will be setting up a NetWare system, you'd better be prepared to understand and

deal with this type of problem.

You'll also have to learn some new concepts involving the "shareability" of files. In the simplest use of the NetWare/S network, you may run programs stored on the shared hard disk; these programs may use files also stored on the shared hard disk. Files stored on the shared hard disk may be flagged as read-only or read/write, and as shareable or nonshareable. The default is nonshareable read/write, but you'll probably want to use the FLAG command to change this to shareable read-only for any program file or any fixed files that a program uses (such as overlays or driver files). Data files should probably remain flagged as nonshareable read/write.

When program files are flagged as shareable read-only and placed in a subdirectory that multiple users have been GRANTED rights to read, they can easily be used by more than one person at the same time. Thus you can have one copy of the Super-Graph-Calc-Comm-Writer integrated program stored as a shareable read-only file on the central hard disk, and everybody can use it.

This arrangement violates end-user licenses, and you may soon expect to see special license agreements (and costs) covering the use of software by multiple users on a network. Until then you may want to discuss the matter with an attorney. You'll probably end up buying a package for each workstation using it, even if only one copy is on the central fixed disk.

Data files that may be used by more than one person should be flagged as nonshareable. This way they're better protected against two people loading the same file, changing it, and then saving it back. When a file is flagged as nonshareable, any program that opens the file will cause NetWare to lock the file against other requests by other users. Only when the first program closes the file will other

users be able to get at it. If someone tries to use a locked file, NetWare produces a display message similar to the one that PC-DOS uses to notify you of a bad disk—"Abort, Retry, Ignore?"

But this isn't always the case. Everything really depends on the way the application uses files. *WordStar* will not allow two users to use the same nonshareable file at the same time ("Abort, Retry, Ignore?"). But Lotus's *1-2-3* will. Apparently, *1-2-3* opens, reads, and also closes a

You can soon expect to see special license agreements (and costs) covering the use of software by multiple users on a network.

worksheet file when reading it into memory. Since the file is closed, NetWare thinks it's available for others. Another user can load the same file into *1-2-3*. When both users try to save the same file and if both don't save at the same time, the last version saved will be the only one on the disk. If both users save simultaneously, one of them will get the "Abort, Retry, Ignore?" message. If you get that message, wait a few seconds, and type an R; you will write over the other version.

The message is simple: Take a close look at how your programs deal with files. Try them out on the network. See if you can wipe out someone else's work. Then determine what you must do to prevent this from happening in a real situation.

If you plan to use your existing single-user PC software packages on the network, be aware that NetWare/S will not automatically synchronize file access so that different users can update the same file simultaneously. If you want two or more users to be able to add, change, or delete records from the same file at the same time, and you want the resulting disk file to represent a composite of these changes, be prepared for additional software costs. You will either have to purchase specialized multi-user database management software packages or spend lots of your own data-processing man-months to write special programs with assembly language subroutines.

The NetWare/S manual says that synchronization for a shareable file requires using extended network functions—record/file locking. These extended network functions are extensions to the normal PC-DOS Interrupt 21 function calls. Novell gives you about the same extent of documentation that IBM does about DOS function calls, plus some technical appendixes, all of which are probably sufficient for anyone who has a good background using DOS function calls in assembly language programs.

Contact Novell for information about the availability of existing multi-user database management programs that will run under their system. They tell me that a forthcoming multi-user version of *dBASE III* will do so.

Using a read-only file from within existing single-user applications program can be very interesting. It's a good test to see how crash-proof the system is. Loading read-only files is no problem with Lotus's 1-2-3 or *WordStar*, but saving them produces different results. Lotus's 1-2-3 wisely and simply reports that it is unable to create the file. But *WordStar* jumps out of edit, bypasses the main menu, and lands back on the PC-DOS

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command level. I have *never* seen *WordStar* behave so badly. I felt as if my best friend had let me down.

Program and file loading from the shared fixed disk is slower than from a local PC-XT hard disk but faster than from a local floppy. If you're accustomed to watching a red light go on when loading a program, the lack of anything happening during disk access may be disconcerting at first.

The first time I tried to use a central printer for printing from the PC workstations, the console monitor kept telling me the printer was off-line. This stumped me for a while, but then I discovered that I had plugged a parallel interface printer into a serial interface port. All I had to do was find a serial printer, very nearly an extinct species.

Novell is aware that the inclusion of five possible serial printer ports and no parallel printer ports is a mistake, and I certainly concur. Serial printers are hard to get running, even harder when the Novell manual tells you that it defaults to 8 data bits and 2 stop bits, an unusual configuration. I finally managed to print nice banners at the head of all my jobs, showing user names in big letters, but the files themselves were pretty garbled. I wished that I could plug a parallel interface printer into the Novell file server.

Installation

One of Novell's technical representative told me he could probably cable and install a small network in about an hour. He suggested it might take someone else less than a day. These estimates exclude time for any special cable routing.

The network interface cards for the PCs are installed the same way you install normal PC expansion cards. Take off the PC cover, shove the card in a slot, screw it down, and put the cover back on. A cable connects the card to the file server. Every

PC also needs a copy of the NET11S or NET20S program. The hard disk must also be configured, and all the NetWare/S programs must be loaded onto it through a step-by-step program.

But to my mind the basic physical setup

Novell's staff can deal with problems by phone. But don't fire your PC expert yet.

and preparation of the hard disk described in the manual is just the beginning. Much of the success of the NetWare/S system, both for normal everyday use and for file security, depends on a good hierarchical subdirectory structure, different for every installation. The person who sets up this structure must have a very good understanding of the work that will be done on the network and a solid background in PC-DOS 2.0 file management. He or she must also learn the entire Novell system. The job involves setting up the various user subdirectories, granting access to these subdirectories, flagging files as shareable or nonshareable, and testing what happens when two or more users try to use the same files at the same time.

Documentation

Reading the manual first is essential for using the Novell NetWare/S system. Familiarity with the 40 new commands is as important as familiarity with the regular PC-DOS commands.

The NetWare/S manual is almost as good as IBM's DOS manuals. It has a similar structure and includes about the same mix of overview, initialization, command reference, examples, and technical infor-

mation, though I believe the NetWare manual tops that of PC-DOS in the number of errors. Also, the NetWare manual is not typeset. But if you have no problem using the DOS manuals and can generally figure things out when documentation is hazy or wrong, you should do okay.

The main manual contains almost everything needed by the person setting up the network, the supervisor, the users, and assembly language programmers who wish to use the additional PC-DOS-like function calls that NetWare adds. A network user would need only some parts of the main manual; smaller manuals for each workstation are available from Novell at extra cost.

The NetWare manual has nothing comparable to the paperback user's guide that IBM included with DOS beginning with Version 2.1 to show you how to correctly insert a diskette. Nor is there an Application Setup Guide like the one that comes with DOS, describing what you must do to get a particular program running on the shared hard disk. The NetWare/S manual does include a wonderful HELP command, however, giving a full-screen description of each command in the system. The HELP command is no substitute for a thorough reading of the manual, but it's a useful, quick, and concise on-screen reference.

The NetWare commands are not entirely consistent and often use slightly different syntax than functionally equivalent PC-DOS commands. Sometimes a command entered with no parameters produces a one-line help message, but most often not. It's my impression that this system was put together by different people at different times, not always in touch with one another. The system also appears to have its roots in CP/M. The sections of the manual dealing with printers makes reference to the LST: device, CP/M talk for the what PC users know as PRN.

Support

Novell's technical staff can deal with user problems by phone, although some that I had were not so easily handled ("My printer doesn't work. How come?"). The technical staff was able to suggest what to investigate.

My overall impression was that the Novell support staff has real experience working on the network and can deal with software problems over the telephone. But don't fire your PC expert yet.

The Rewards

A network like the Novell NetWare/S system should be considered an extension of standalone PCs. My nightmare is a cost-conscious manager equipping an office with 24 stripped-down diskless PCs, all connected to a centralized hard disk and printer. Those of us who have worked on large share systems often prefer full PCs because then the machine spends all its time serving one user. Let's not retreat from this very important advance. If ten people each need to use a \$3,000 letter-quality printer 10 percent of the day, the network surely makes sense. If one area of a company consolidates information on a PC file from several other areas, storing these files on a centralized hard disk sure beats sending floppies through interoffice mail. If copier paper and time are constantly being wasted duplicating numerous widely distributed memos, keeping the memos on the hard disk and notifying everyone of them through MAIL is a better way. If everyone needs to use the company's rate calculation program, filing it in a PUBLIC subdirectory means that everyone will be using the latest version.

Novell's NetWare/S can handle all these office needs. It's somewhat more difficult to use than PC-DOS, but if you invest the money, time, and training, put in the work, and keep the system up to date, you'll be rewarded.

Orchid PCnet

Flexibility and advanced features team up in this simple system of modest speed. The complexity is in the installation.

Orchid Technology's PCnet is a coaxial cable-based, distributed-bus network that gives not just the expected network conveniences—file and device sharing—but also adds advanced features like messaging and remote booting of diskless workstations. Up to 256 workstations, which can be separated from one another by more than a mile, can tie into the network.

Each workstation in the network requires either an Orchid PCnet expansion card or an Orchid Blossom multifunction card with a network adapter. By means of the network software supplied with the PCnet hardware, one or more of the disk drives of any PC in the network can be sectioned into a collection of user volumes, or virtual drives, that are accessed by the other workstations in the network. Once the installation procedure is completed, the servers still perform their normal workstation functions, regardless of the fact that they are providing almost all of the network horsepower.

This last point is one of the major advantages of the PCnet philosophy—no expensive, dedicated network server is necessary. However, dividing an XT between running a network and providing local computing resources to a single user can be a mixed blessing—performance on the servers is slowed because of the sharing of their resources.

Robin Webster and Winn L. Rosch

Technical Summary

Orchid Technology's PCnet is a base-band network that can handle data at up to one million bits per second using the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) technique to control access to the system. Up to 256 personal computers—a mixture of diskless PCs, floppy-based PCs, and hard-drive systems—can be linked with PCnet.

The PCnet system can have one or more servers. Each user workstation can access up to 14 servers (actually, the PCnet software limits each user to 16 devices, which include the two disk drives built into the average PC). Servers, however, cannot directly access other servers on the network.

For review purposes, we used an "average" network built from one 640K IBM PC-XT as the server and three 640K PCs as user workstations. Together with the PCnet cards, we installed Orchid Blossom multifunction cards to provide the extra RAM and an onboard system clock. All the computers were set up in one room.

In operation, PCnet uses two interrupts and one direct memory access channel. As set up from the factory, PCnet cards use interrupts 3 and 2 and DMA channel 1. This arrangement works satisfactorily with systems that use only hardware made by IBM. But because other third-party manufacturers may use these same control signals for hard disk drives and other peripherals, interrupt and DMA conflicts may

NETWORK SURVEY

cause problems in the operation of both the network and other peripherals.

Orchid allows the default values used by the PCnet system to be changed by moving jumpers on the network adapter cards. Nevertheless, the PCnet may be incompatible with some hardware.

Installation

Installing the PCnet expansion cards into individual workstations is straightforward. No special tools are needed, because the PCnet system employs simple twist-lock, BNC-type connectors.

Laying the cable may be another matter. Either you must use a special tool to crimp the coaxial connectors on the individual cable lengths you make, measure each cable run, and have the cables custom-made; or you must use stock-length cables and coil up the excess length (burying it somewhere in the system).

Tapping into the cable involves inserting a T-connector between two individual lengths of cable and attaching the workstation as a tap. Adding a new workstation therefore may involve temporarily shutting down the network. The coaxial drop line between workstation and the network cable can be up to 20 feet long.

The cabling of our small, four-station network caused no great hardship, because the individual computers sat next to one another. However, upon installing the network cards, we came across a rather unexpected problem.

When the network is set up, each PC, including each server, must be given a unique identity, or network address. In PCnet's case, the ID tag for each node is set up via a DIP switch on the PCnet card.

After setting the user PC boards to what we believed were hexadecimal addresses 11, 12, and 13, we rechecked them via the PCnet software. To our surprise, two of the user PC boards believed they were set

to address 13. After rechecking the board settings, we found that number 11 refused to budge from being 13.

To get the network up and operating, we opted to switch the real number 13 board to another address—18. However,

upon checking again, this board turned out to be having its own problems—to the system software, it registered an address of 1A (hex). Since both the boards seemed to have such strong convictions about which addresses they wanted to be, we decided to

LAN FACT FILE: ORCHID PCNET

Marketed by:

Orchid Technology
47790 Westinghouse Dr.
Fremont, CA 94539
(415) 490-8586

Network Description

Architecture	Bus
Type	Baseband
Speed	1 Mbit/sec.
Server Type	XT

Retail Prices

Starter Kit	\$ 1,090
Workstation	\$ 495
Server Station	N/A
Dedicated Server	N/A
Cable (per foot)	30¢
Connector	included
Repeater	N/A
Four-Station Configuration	\$ 6,475

Security

Logon ID	<input type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Hardware Capabilities

Configurations:

No. Servers	0-16
No. Workstations	2-256
Server Type	XT

Memory Min./Max.

Dedicated Server	N/A
XT Server	256/640K
Workstation	256/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input type="checkbox"/>
Modems	<input type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input type="checkbox"/>
Other	<input type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
RAM- or Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input type="checkbox"/>
Type	<input type="checkbox"/>
Global?	<input type="checkbox"/>

go with this arrangement.

The problem was not serious; it was probably caused by sticky DIP switches on the boards. Rigorous flipping of the DIP switches during a second installation of PCnet seemed to have some effect, and proper switch settings could be chosen.

Unlike many other heavyweight network operating systems (Novell's NetWare, for example), all software for Orchid PCnet, both installation programs and utilities, fits onto just one diskette. Several batch files are used to simplify software installation.

Still, installation becomes a tedious trip through the documentation. Although the manual is typeset and makes use of many illustrations, it is extremely difficult to comprehend. Just when you think you are about to get somewhere, the text makes abrupt changes in topic or emphasis. And it has some serious gaps.

(The manual does have one saving grace that should help those experienced in the intricacies of PC-DOS get through the installation process unscathed—a chart that lists exactly what files must be on what disks, and what commands must be in each AUTOEXEC.BAT and CONFIG.SYS file to get the network running.)

Although a nicely printed network planning sheet is provided by Orchid, it serves merely as a log for any configuration work you do. It does not provide prototype examples or offer advice that a new network user might find helpful.

According to an Orchid spokesman, the documentation is being revised, and the new version will remove much of the confusion by providing more succinct directions and a one-page "quick install" procedure.

Assigning Volumes

Once you have the software where you want it, you must ready the server station

for network operation and create a series of boot disks—one each for every computer in the network. The hard disk of the server must be divided into as many volumes, or virtual drives, as will be required by the network.

Each volume may be of any legal size (PCnet restricts individual volumes to a

The less-than-robust MAKEVOL utility proved not to be atypical; all the installation utility programs were fragile.

maximum of 9,999 kilobytes) and must be given a unique name.

The MAKEVOL program is used to create each user volume, and you will no doubt end up running the program a good many times—mainly because you are required to give so many precise responses and will probably not get them all right the first time around. There are almost no opportunities to correct single errors—you must crash the program by typing Ctrl-Break and start all over again. Sometimes, just accidentally entering a character or number out of place will cause the program to crash.

Alas, this less-than-robust MAKEVOL

utility proved not to be atypical; all the PCnet installation utility programs were similarly fragile.

After you create the user volumes, you must decide what type each one is to be. You have three practical choices: public read-only, public read-write, and private read-write. (Although you can have a private read-only volume, that choice is not useful.)

After the various volumes are created, they must be assigned to the workstations that are to use them, a process called "mapping." To the individual user PC, each volume appears as a separate disk drive with its own, DOS-assigned drive letter. These drive letters are then mapped to correspond to specific volumes on the server PC, using a program called UPCINST.

Orchid and Application

PCnet allows individual workstations to run many MS-DOS programs such as *1-2-3*, *Framework*, *WordStar*, and *dBASE II*. For the most part, running these programs on the network is easy—you need only load them from the virtual disk corresponding to the public volume of the server on which they are located. Save for the absence of a spinning disk drive (and a delay should the network be busy), the individual workstation operators might not notice that the software had been whisked through a wire. However, the copy-protection schemes of *Framework* and *1-2-3* still require that the program's system disk be in drive slot A: of each workstation to start the program running. (continued)

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Database
Orchid PCnet	731	152	192

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NETWORK SURVEY

Although Orchid is obviously aware of some of the problems in trying to run single-user PC-DOS software (protected and unprotected) in a networked, multi-user system, the few pages devoted to this subject in the installation/user manual were a disappointment. The information is lightweight, considering that PCnet was specifically designed for use with one machine, the IBM PC, and considering the popularity of the programs that are available for that machine.

Orchid does give several hints on taking best advantage of PCnet, using *WordStar* as the principal example. Orchid recommends that you store all text files on the server's hard disk and have each individual workstation execute the *WordStar* program locally.

WordStar, like many other MS-DOS programs, uses overlay files to provide a wide range of menu commands to machines with modest amounts of memory. Each time an editing command is issued, *WordStar* checks to see if it has the necessary code to execute that command in RAM memory. If not, it loads the necessary code from an overlay file, a "page" of program code located on a disk.

If you try to run *WordStar* through the network, rather than putting all the overlays in the user PC, it must access (and tie up) the network whenever some very elementary functions are needed. The network begins to suffer dreadfully as a direct result of attempting to ship program overlay files to each user as he or she needs them.

File Locking

When multiple users attempt to share files, problems are likely to occur. The worst problem occurs when two stations try to write to a single file at the same time. The possible outcomes are all bad—either the file could be confused, damaged, or destroyed, or, unknown to either party,

important data could be permanently lost in the shuffle.

A common scheme to prevent such interference is called "file locking." Orchid PCnet uses a less-sophisticated file-locking method: flags or "semaphores" that merely indicate a file is in use. Because the semaphore is a signal—rather than a physical barrier—it can be (and often is) ignored by some application programs.

The weakness inherent in the PCnet semaphore locking scheme showed itself

One of the nice features of Orchid's PCnet is PCNETTLK, which allows any workstation to send text messages to any other station.

when we tried locking files using the "R" option (for "Run a Program") from *WordStar*'s main menu. Although the Orchid documentation states that you can run the LOCK utility from within *WordStar* via the "R" command, when we tried doing so during our review sessions, the locking did not seem to work correctly. Even after a message indicating a file had been locked was displayed, other *WordStar* users could access the supposedly locked file without being given any warning. Orchid's intentions aside, in the real world semaphore systems do not provide sufficient file protection to save important files from beginner's bumbles or premeditated attacks.

Network as Telegraph

One of the nice features of Orchid's PCnet is its electronic message system, called PCNETTLK, which allows any workstation to send electronic text messages to any other station.

To access the messaging system, each user must first type in the PCNETTLK command followed by a chosen reference name at the DOS prompt—or, what's more likely, in the workstation's AUTOEXEC.BAT file. Thereafter, hitting the Alt-T key combination will display the PCNETTLK main menu. When the menu is not shown, the program stays accessible in memory—even while another applications program is executing.

Messages can be sent to any specific network workstation, provided that station has invoked the PCNETTLK program (which needs to be done only once, when the machine is turned on). When a message is received, the computer beeps and a blunt YOU HAVE MEMO legend appears on the bottom right of its display. This highlighted notice overwrites whatever is on that area of the screen, but it doesn't permanently interfere with applications program screens.

The maximum message length PCNETTLK can handle is 17 lines of no more than 80 characters each. Each workstation can store only one message—the most recent one received—and new messages automatically overwrite the old ones. PCnet makes no provision for saving these messages to disk.

Supercharging the Network

PCnet's relatively modest data rate of 1 megahertz limits its overall performance. Files load through the network faster than from floppy disk, but more slowly than from an XT's hard disk. Response becomes even slower—stretching into long seconds—when there is traffic on the network cable.

Orchid includes several programs with PCnet that, when properly used, can speed up the network, including disk caching and RAMdisks.

Many programs constantly look for data stored on disk, like *WordStar*'s searching for overlay files. As a result, performance is often limited by the disk I/O transfer rate. Disk caching is a method of keeping the "most-recently-used" chunk of disk data in memory so that these rather unwieldy programs may access that data at solid-state memory addressing speeds.

PCnet's disk caching feature is enabled either by entering the PCCACHE command (plus the relevant parameters) in the server's CONFIG.SYS file, or by typing PCCACHE at the DOS A> prompt. The PCnet caching scheme is elaborate (as such schemes go) and will even hold data to be written to disk in a RAM buffer, writing it to disk as time permits.

Of course, the data held in RAM before being written to disk is vulnerable to power failures and the like until it actually gets to the disk. The Orchid caching software allows the system manager, in setting up the network, to choose the maximum wait—up to a minute—after which getting the data written to disk, where it is safe from power surges, takes priority over other matters. Further, the write-cache can be immediately flushed to disk by typing Ctrl-Break or running the program CFLASH.

Orchid also thoughtfully includes RAMdisk software with PCnet, so if you have the Orchid Blossom multifunction card installed (or any nonconflicting multifunction card), you can assign the RAM memory on that board to act as a high-speed disk emulator.

Advanced Features

User workstations in the PCnet network can, to a limited extent, run programs on

server stations using the network's RE (remote) facility. If a shared drive is the default setting or if a shared drive is specified in the command, typing RE followed by any legal command will cause execution of that command at the shared computer—provided that the power to run programs remotely on that server was granted that user station when the network was set up.

Because the RE command functions by merely sending a command line to the server, no input can be given to the remote

P Cnet's strongest point is its versatility. Any PC in the system can function as both a workstation and a server. No dedicated server is required.

program once it's running. PCnet can handle several remote commands per server. All remote commands are queued at the server and executed on a first-come, first-served basis.

User stations (except for those based on the early model PC1 computer) can boot DOS from the network by adding an optional ROM chip to the network adapter card. A special boot volume must be created on the server for each user station wanting to boot from the network. The boot volume takes the form of a 160K virtual floppy disk, complete with the disk operating system on it. (It can also be used for storing other programs and data, up to its capacity.)

If the user station with the boot option has no disk drive or if its A: drive is not ready, it will boot from the network. As with an XT, if the A: drive of the user station is ready at turn-on, the computer will boot from the disk in that drive.

Both serial and parallel printers can be shared by the network. Although individual printers can be physically attached to any PC in the network, Orchid warns against connecting them to servers (they already have their hands full running the network) or attaching more than one printer to any PC (only one printer per PC can be accessed by the network at any one time).

PCnet also allows the sharing of modems. At present, however, this feature is not useful. Orchid requires that a special interrupt be used for controlling shared modems, and the PCnet manual notes that no known communications software uses the required protocol.

Overall, PCnet's strongest point is its versatility. Any PC, XT, or whatever in the system can function as both a workstation and a server. No dedicated server is required. Of course, that benefit is mitigated somewhat by the inability of servers to share with one another.

For a relatively simple and inexpensive network, PCnet has all the expected features—such as file and printer sharing. And it has many options that might be expected only in a more expensive arrangement—such as remote command execution and messaging—albeit in rudimentary form.

Although PCnet's 1-megabit-per-second communication speed is modest, particularly on coaxial cable, it should nevertheless be sufficient for smaller systems or those without heavy file-sharing demands—once the intricacies and inconsistencies of the installation are sorted out and the system is put into everyday operation. ■

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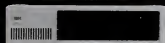
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Quadnet VI

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Quadnet VI from Quadram Corporation is a relatively low-cost, medium-performance local area networking system. Actually, Quadnet VI is Gateway Communications's G-Net, which Quadram is reselling under its own name. Both companies offer this network in conjunction with the NetWare operating system, from Novell, Inc. Quadnet VI's features include all the security, spooling, and backup features supplied with NetWare, plus relatively simple installation and standard cabling techniques.

Applications

As with the other NetWare-based systems, all the software we tried ran without problems. Specifically, we tried *dBASE II*, *WordStar*, *Multiplan*, as well as *LAN:Datastore*, *1-2-3*, *Framework*, and a few others.

To install *1-2-3* and *Framework*, you simply follow the procedures for hard disk systems in their manuals. We installed both programs from a PC workstation onto the hard disk server without a single glitch. In fact, the person who installed them had never worked with either program before, so he slavishly followed directions. It's still a nuisance to operate these programs because the copy-protected disk has to be in floppy drive A: on the workstation that initiates the run, but this complication is no

different—nor are the program's operations, in general—from those of the stand-alone mode. With the bulk of the programs on the hard disk server, a workstation user has the impression that he is working at an XT.

The excellent spreadsheet design of *1-2-3* will undoubtedly lead many Quadnet VI users to load it onto the network. It is not designed for multi-user or network applications, but Quadnet VI's file-locking FLAG command can be invoked to enable multiple users at workstations to use the *1-2-3* system file collectively, while keeping data files accessible to only one user at a time.

Like *1-2-3*, *Framework* uses a copy-protection scheme that requires that the original system disk (or its backup copy) be inserted in one of the floppy drives of the user's station. This requirement flies in the face of the whole idea of networking and, in this particular case, is dangerous to the end user because it requires that the write protect tab be removed from the system disk each time it is used. Therefore, a careless user can easily erase, overwrite, or reformat the disk without a moment's notice.

When *Framework* is first invoked, it presents a list of available drives in a vertical column on the right-hand side of the screen. Then each available disk drive is represented by its drive designator letter plus a colon. For example, if the system is

configured with two floppy drives plus a RAMdisk, the letters A:, B:, and C: would be shown on the screen. In Quadram's Quadnet VI, the hard disk server is subdivided into virtual volumes and given drive letter designators from C: through Z:. These "virtual drives" act like disk drives, while they are actually merely sub-directories of the hard disk with a drive letter designator. *Framework* looks at the operating system to see how many disk drives are installed, so when you use Quadnet VI, it gets the message that the highest drive installed is drive Z:. However, PC-DOS does not officially recognize the possibility of 26 separate drives. Moreover, *Framework* doesn't seem to be able to handle that many drives and assigns drives up to the letter J:. So, if you are using Quadnet VI, you must remember that files that need to be accessible by *Framework* must have a letter designator between C: and J:.

The Ideal Program

WordStar is an almost ideal program to run in a network environment; it's not copy protected, so it's easy to load onto a hard disk with no special-disk-in-drive-A: scheme to slow things down, and it can be set to acknowledge almost any drive designation as its default drive. Also, networks tend to run all word processing programs quite efficiently because of the light amount of actual data flow that appears across the bus. *WordStar* doesn't recognize path names, but it does allow switching from one logged drive to another. Actually, there's only one problem with running this program on any network: If you don't take the precaution of writing your text files in a private directory or volume, another person running *WordStar* at the same time may wipe out your file, or your attempts to save a file might fail.

We encountered problems using *dBASE II*, Version 2.40, on Quadnet VI.

Peter Feldman and Kent Porter

However, a new release (Version 2.41) behaves properly when used with Novell's CPMON command, which exists primarily to support such applications as *dBASE II*, which was designed for CP/M and has retained some bad file I/O habits.

A few utilities, including *ProKey*, that do direct hardware calls will not execute properly in the server XT. But if your application is written using only the legitimately documented software calls to DOS, you should be fine (see "The Novell

Solution" in this issue).

Hardware

Quadnet V1 utilizes a bus architecture, with a transmission speed of 1.43 megabits per second and baseband technology. Unlike its bigger brother, Quadnet IX, which is a token-ring passing network, this network relies on Carrier Sense Multiple Access with both collision detection and collision avoidance (CSMA/CD/CA). The use of both CA and CD is a novelty. With collision avoidance, before sending a packet of data across the bus, a station first "listens" to determine if the bus is already in use. If it is, the station waits a random length of time and listens again. This process continues until no activity is sensed; only then does transmission begin.

With collision detection, if, after transmission begins, a collision with data packets from another station is detected, then both of the involved stations back off the bus, stop transmitting, wait for random amounts of time, and try again. Using both CA and CD is more reliable but is also more complex and possibly slower—because of increased software overhead—than using only one of these methods.

Required cabling for Quadnet V1 is shielded coaxial (75-ohm) RG 62, 59, or 11. The maximum end-to-end distance (maximum bus length) using the above coaxial is 3,500, 4,000, or 7,000 feet, respectively. Of course, the cables that are capable of longer distances are more expensive, and, with any of the cables, longer runs must be grounded every 200 feet. This could prove to be a hassle, depending on what you've got in the way of cold water pipes and wire strippers.

Coaxial cable BNC "T"-type connectors are used to add new workstations to the bus—an easy, reliable, and sturdy arrangement. However, the network must go "off the air" temporarily while a new user is being added; this can be a nuisance

LAN FACT FILE: QUADNET V1

Marketed by:

Quadram Corporation
4357 Park Dr.
Norcross, GA 30093
(404) 923-6666

Retail Prices

Starter Kit	N/A
Workstation	\$ 595
Server Station	\$ 1,295
Dedicated Server	N/A
Cable kit (100 ft.)	\$ 95
Connector	N/A
Repeater	N/A
Four-Station Configuration	\$ 8,070

Hardware Capabilities

Configurations:

No. Servers	1
No. Workstations	0 - 255
Server Type	Both
Memory Min./Max.	
Dedicated Server	256/640K
XT Server	384/640K
Workstation	128/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input type="checkbox"/>
Other Mass Storage	<input type="checkbox"/>
Modems	<input type="checkbox"/>
RAMdisks	<input type="checkbox"/>
Other Communications	<input type="checkbox"/>
Other	<input type="checkbox"/>

Backup

Vendor-Supplied	<input type="checkbox"/>
Tape and Disk	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Bus
Type	Baseband
Speed	1.43 Mbits/sec.
Server Type	Dedicated/XT

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input type="checkbox"/>
Server	<input type="checkbox"/>
Workstation	<input type="checkbox"/>
Network/Station	<input type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input checked="" type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

NETWORK SURVEY

in a busy office environment.

The minimum configuration (servers/workstations) is one file server. One server and one workstation is the beginning of a network on Quadnet VI, and upward growth to a maximum number of 255 user workstations is possible. However, only 50 stations can access the net at one time. If you happen to be the 51st user trying to access the server, a message explains that you will just have to wait.

This may, of course, be a moot point because of another limitation. Since Quadnet VI supports only one server, running even 50 workstations may be optimistic. However, a new release of "advanced NetWare" in the first quarter of 1985 will allow multiple servers on a network.

As with Quadnet IX, XT servers should sport at least 256K RAM to operate as dedicated mode servers. If you wish to use the XT as a server/workstation, you need a minimum of 384K RAM. This will allow 128K RAM for applications programs. Workstations need 128K minimum. Any IBM PC or XT will do just fine on this network. In addition, Quadram claims that the Compaq Plus, Compaq Deskpro, Eagle Spirit XL, Columbia MPC, and TI Professional are also compatible.

Some compatible add-on hard disks may also work. As of this writing the Tall-grass hard disk subsystem was not acceptable, but, according to Quadram, it will be by the first quarter of 1985.

Peripheral Vision

One of the principal attractions of networks is that they enable many worksta-

tions to share expensive peripherals. Quadnet VI supports the sharing of standard PC-compatible printers, laser printers, the system hard disk, plotters, and tape and other mass storage devices. Quadnet VI does not allow the sharing of devices that are attached directly to the user workstations, but they may be used locally. As for the server, a maximum of three devices, using any combination of the two serial and three parallel ports, is allowed. Laser printers seem to work fine with Quadnet VI, but, for some reason, plotters don't.

Server-based modems are not yet supported, so to get on-line you will have to pass a modem board around the office or buy a bunch. Ditto for RAMdisk and multifunction boards, as well as specialized micro-mainframe communication boards such as IBM 3270 terminal emulators.

System Software

The system software is Novell's NetWare, which allows you to run your XT server in either a dedicated or nondedicated mode. This package is well thought out, with plenty of security features for insuring data integrity and protection.

Quadnet VI furnishes a comprehensive set of utilities for data security—an important concern when any network is in use. Utilities, such as MAKEDIR, RIGHTS, GRANT, and REVOKE, cover a wide range of tasks, from creating a new subdirectory to defining access rights for each individual directory.

As mentioned earlier, files created in the Quadnet VI/NetWare environment are

automatically given read-write nonshareable status—that is, two or more users cannot gain access to the same file concurrently unless the file has been explicitly set to shareable status by the system's FLAG command.

While the FLAG command is not exactly the same as file locking, it is analogous. In effect, the FLAG command allows the owner of a file (the user who

Laser printers seem to work fine with Quadnet VI, but for some reason, plotters don't.

controls the subdirectory in which it resides) to declare whether or not it can be concurrently accessed, and this status prevails for the life of the file or until FLAG is used once again to change it.

With *WordStar*, we made the program and overlays nonshareable, and two users attempted to run the program at the same time. The first user could work as normal, but the second got an error message saying "Network Error: File in use during OPEN." DOS-like Abort/Retry/Ignore/ options were then offered. Retry and Ignore consistently produced the same message as long as the first user continued to run the program: the Abort option returned the second user to the command line prompt.

Later, we changed the *WordStar* file to a shareable status and then attempted to have two users edit the same file again. We got the same error message, but this time it named the document file (which was not shareable).

The Quadnet VI documentation strong-

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Dastore
Quadnet VI	438	114	95

ly recommends that the shared XT disk server not be run as a workstation; rather, it should be reserved as a dedicated network control node. The manual goes on to discuss at length why a nondedicated server produced less than satisfactory service. A very good reason, which is not discussed in the manual, is that a dedicated server can then run in Monitor mode. The Monitor mode furnishes a dynamic display, partitioned by workstation, of all network activity; it's a powerful tool for network management, showing not only which nodes are active, but what they're doing (OPENS, CLOSES, and so forth) and where bottlenecks are occurring.

Printing

The Quadnet VI print spooler is powerful and versatile, allowing direct printer output directly from applications programs to be captured for deferred printing. In addition, there are commands for determining who has output in the spooler and when it will be printed, to cancel pending reports, mount special forms, and a lot of other useful things.

Network Backup Facilities

Although Quadram plans to introduce its own tape backup system soon, other explicit network backup alternatives already exist. You can back up the complete system, a specific subdirectory, certain files within a directory, or files that were modified since the last backup. You can achieve all of this by using a prompt-driven program called *T-Archive* from Novell, or you can do the job with other existing tape units. For instance, you can use the TIP system sold by Alloy Computer Products and driven by Quadram's own tape backup program.

Backup can be performed only from a workstation (an interesting twist), or from a server running in nondedicated mode. Of course, backing up to floppies is possible,

even though putting 10 megabytes on floppies takes about 30 disks and a lot of time. Since NetWare can handle up to 8 hard disks using various manufacturers' devices, you may end up having to buy disks in quantity.

For other details on the system software, see the article on the Novell Net-

Ware network operating system in this issue, "The Novell Solution."

As with other Novell networking systems, all MS-DOS/PC-DOS versions except Version 1.0 are supported, and applications designed to operate on CP/M 86, Concurrent DOS, UNIX, and XENIX are not usable.

(continued)

Good Help Is Hard to Find

Quadnet VI's help system is effective, interactive, menu-driven, and downright fun.

By any measure, the Quadnet VI help facility is superior. It's an interactive, menu-driven system accessible via the HELP command. The system is broken down into three topics: how to use HELP, the user commands, and the system operator commands.

The how-to screen manages, through a combination of text and graphics, to summarize everything about operating the help facility on one nonthreatening panel. For example, to even the greenest computer user, this screen makes it clear that you press the Backspace key to back up the most recent display.

The command sections cover aspects of the network pertaining to users and the systems operator. When you select one of these topics, you get a list of all its commands. The arrow keys let you move the cursor to the command you want to know more about. When you press the Enter key, a one-panel display

explains the purpose of the command and its syntax and gives several practical examples with explanations. The syntax section is a bit eye-boggling at first, but it follows the same notation that's used (and clearly explained) in the manual. Some of the command panels lead to optional screens showing related commands and background information, a rich source of concise, practical information about the network.

At the bottom of each screen are several action options you can select with the Home and arrow keys. While it is not always obvious what these choices mean, the system is so effective, risk free, and downright fun that you are inclined to experiment. It's possible, after a short briefing, to operate Quadnet VI by referring only to the on-line help system without consulting the manual. That's a help system that truly deserves its name.

—P.F. and K.P.

NETWORK SURVEY

Favorable Performance

Quadnet VI's performance, both in terms of reliability and benchmark test execution, favorably impressed us. This system is robust; it's not prone to unexpected behavior (except for the normal Novell anomalies) or to accidental data loss due to application program collisions—thanks to NetWare.

With the exception of the failure that all NetWare-based systems suffered while attempting to run our *LAN:Datastore* test, Quadnet VI clocked in among the best. It clearly whipped Orchid, 3Com, and the Nestar PLAN 3000 (all running their native operating systems) in several of the more savage tests, was a tad faster than Ungermann-Bass, and did not come in too far behind TeleVideo.

Installation

The first installation task to confront potential users of the Quadnet VI network is that they must set up the node addresses on all network boards.

While this may seem to be a simple affair—setting a few on-board switches and such—the task is governed by some specific rules: no two nodes can have the same network address; the server network address must always be set to 255; and address 0 must be reserved as the broadcast address (for all nodes).

In contrast to many other networks that simply require you to install properly configured boards and network operating system software, the Quadnet VI system documentation notifies you that you must modify both the network card and the operating software in one interdependent procedure that is presented in the form of a question-and-answer dialog.

Not until this first step is completed does the operating system show you (by means of graphic images plus text) how to set the network card, the switches, and the jumpers. Although this appears to be quite

a nice idea, it has one major drawback: If you provide incorrect information during the question-and-answer session, you will be supplied with the wrong board configuration data.

Further along during board installation, you have to set the board to identify where

Quadnet VI clocked in among the best. It clearly whipped Orchid, 3Com, and PLAN 3000.

Quadnet VI's 64K of memory is to be located. We believe you must have a better-than-average knowledge of memory allocation to be comfortable with this installation procedure.

Setting I/O Addresses

Just when we thought we had a green light to install our board into a PC, it turns out that we still had to check the network board's I/O address for conflicts with other PC-installed equipment. Luckily, the Quadnet VI board default address of 2E0 is neither reserved nor used by a standard PC configuration, so no direct conflicts can be expected there.

You should be aware, though, that other add-on boards, such as multifunction, RAMdisk, or communications boards may use the same I/O addressing scheme as well. If problems do occur in this manner, you'll be on your own because the Quadnet VI documentation does not really go into the possibilities in detail.

The next step in the board configuration process involved the service request interrupt. The default employed by Quadnet VI is IRQ3, which is the same as that

employed by a COM2: port. Since the PC's attached to the review network were not equipped with a COM2: port, there was no problem. In more difficult circumstances, the service request interrupt may be reassigned as IRQ2, IRQ4, or IRQ5 to give that little extra flexibility.

The Quadnet VI implementation of Novell NetWare is quite standard: it regards the hard disk as one huge resource going under the name SYS:PUBLIC; user volumes (little more than discrete areas on the hard disk) are established by building DOS subdirectories.

Subdirectories can be created using a Novell utility called MAKEDIR. The entire subdirectory can be flagged at the time of its creation to make the files it will contain shareable or nonshareable. Regardless of how you set a new directory, the operating system will ensure that new files are initially set to a nonshareable read-write status.

Documentation

Quadnet VI furnishes a single manual that suffices for both network management and users. It's in the usual IBM manual size and format, printed on heavy paper, and organized into a preface and seven sections. Although very thorough and well-written, the documentation tends to be wordy, with long text passages unrelieved by examples. The manual begins with an overview of network technologies and then proceeds into the installation process. The procedures are rich with drawings showing how to hook up components, set switches, and so on. A cookbook approach prevails, and the clearly written instructions explain not only what to do but also why you have to do it.

Each of the manual's seven sections deals with a specific area, including getting started, security, system monitor operation, a programmer's guide, and more. The manual doesn't provide any

help for finding information; its sections are cryptically tabbed and entitled with letters, and it doesn't have an index. There is an extensive table of contents at the front of the manual, but the reader is given no choice except to hunt sequentially through it. It's a shame the manual seems to supplement the help system rather than the other way around (see the sidebar "Good Help Is Hard to Find").

Support

Quadnet VI offers very little in the way of diagnostics software. Once again, our feeling is that this is an oversight that may cause unnecessary headaches for potential users. Quadram does make a board-level diagnostic test available upon request, but this only tests the board, not cable integrity, server integrity, or station-to-station communications.

Quadram offers a 1-year warranty on its products, with parts and labor included. Return shipping is prepaid, and the company claims the average turnaround time on repairs is about 1 week. Although no on-site service or third-party drop-service arrangements are currently available through Quadram, telephone-based technical support to end users, dealers, and distributors is available.

Quadnet is a good, solid implementation of a baseband coaxial network. Notwithstanding the overelaborate spooler and other matters already discussed, Quadnet VI gets high marks from our test group. The system is solid, with only a few significant bugs, thus giving you a feeling of confidence and reliability. It's true that if your programs don't follow PC-DOS rules strictly, XT servers have problems operating as a workstation, but the manual warns you about that. We admire Quadram for having the self-confidence to admit Quadnet VI's weak spots and steer you away from them. And we applaud a product that performs so well. ■

Quadnet IX

Quadnet IX's ultra-speedy data transmission and unusual ring-and-star workstation arrangement set it apart from the crowd.

The Quadnet IX is Quadram's re-packaging of Proteon's Pronet. This network sends data between PCs at a whopping 10 megabits per second, using a combination of proprietary hardware and the Novell NetWare software. The overall design of this network sets it apart from the others reviewed in this issue. Instead of the usual CSMA/CD, this package uses a token-passing protocol to regulate the flow of data, which guarantees quick transmission even when the network is heavily loaded. The layout of workstations is based on a unique combination of ring and star arrangements.

In Quadram's lineup, the Quadnet IX is the big brother of the Quadnet VI, handling more workstations and allowing faster data transfer. The two networks are based on different hardware from different vendors, but both use the Novell NetWare system software.

Stunning Hardware Capabilities

The Quadnet IX technology resembles the ARCnet topology used by the Davong and Nestar networks. The difference is in the speed and transmission medium; Quadnet IX transmits at 10 megabits per second and uses shielded twisted-pair cable or fiber-optic cable.

The host interface in the Quadnet IX consists of PC cards that plug into any

available full-length slot in the PCs or PC-XTs. The interface cards contain all the logic to implement the physical, link, and network layers of the ISO's Open Systems Interconnection protocol. They have separate 2K buffers and can transmit and receive packets at the same time, with little or no assistance from the host processor. The Quadram documentation provides only sketchy information concerning the board hardware, but they appear to use proprietary technology developed by Proteon.

Quadnet IX uses neither a bus, ring, nor star arrangement, but rather a combination of star and ring designs. In this token-passing, star-shaped ring network, workstations are connected in a star fashion via a wire center.

The wire center, which is similar to the Davong system's hub, serves as a connection between 4, 8, or 16 workstations per ring. It also maintains system integrity by preventing the loss of the token owing to a defective or disconnected workstation. Using a relay (electromagnetic switch), it will automatically disengage the faulty workstation from the ring and close the resulting gap. If the voltage on a node drops because of a power failure or node hardware problem, the relay responsible for joining that PC to the network will bypass that node's connection. (continued)

Robert Cowart, Steve Kanzler, and Steve Rosenthal

NETWORK SURVEY

The wire center allows you to manually disconnect a workstation from the ring, and indicator lights identify faulty circuits. Also, since all nodes are electrically separated from one another through isolation transformers in the wire center, a serious

power supply problem in one machine will not cause damage to all the PCs on the ring.

According to Quadram, the Quadnet IX's star-shaped ring layout usually allows faster transmission of data than bus-struct-

ured networks. Since the token signal is repeated at each node, signal quality remains high, even in electronically noisy environments.

The Quadnet IX allows you to create a huge and versatile network. The system can accommodate a total of up to 255 nodes when a number of rings are connected together in an arrangement called a "string of stars." This requires joining the connectors on each of up to 64 wire centers, so it may involve a little advance planning or rewiring. The Quadnet IX also interfaces with the DEC Unibus (used in the VAX and PDP-11 series minicomputers), the DEC Q-bus (for micros), and the Intel Multibus. This means you can interface your PCs to minis, superminis, and mainframes.

Quadnet IX supports one parallel and two serial network printers, which must be connected at the server. It will run both standard PC-compatible printers and laser printers. Other devices than can be shared from the server include plotters, the XT hard disk, and mass storage devices. Quadram recommends the Alloy tape backup system and supplies a tape backup program for this device. Currently, there is no arrangement for sharing server-based modems, RAMdisk or multifunction boards, or other communication boards (such as the IBM 3270 terminal emulator boards). Each workstation can also have additional devices, but these cannot be shared by other users on the network.

One problem with all the networks that use Novell's NetWare system software is lack of compatibility with standard DOS device drivers. To support peripherals, Novell must provide its own device drivers, owing to the proprietary nature of the Novell file server.

Expect to use a lot of memory for this network. Your servers need at least 256K RAM to run in dedicated mode and 384K for nondedicated operation. For maximum

LAN FACT FILE: QUADNET IX

Marketed by:

Quadram Corporation
4357 Park Dr.
Norcross, GA 30093
(404) 923-6666

Retail Prices

Starter Kit	N/A
Workstation	\$ 795
Server Station	\$ 1,495
Dedicated Server	N/A
Cable Kit (100 ft.)	\$ 95
Connector	\$ 195 (4 stations)
Repeater	N/A
Four-Station Configuration	\$ 9,265

Hardware Capabilities

Configurations:	
No. Servers	1
No. Workstations	256
Server Type	XT
Memory Min./Max.	
Dedicated Server	256/640K
XT Server	356/640K
Workstation	128/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input type="checkbox"/>
Modems	<input type="checkbox"/>
RAMdisks	<input type="checkbox"/>
Other Communications	<input type="checkbox"/>
Other	<input type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Tape and Disk	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Ring
Type	Baseband
Speed	9.92 Mbits/sec.
Server Type	XT

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input type="checkbox"/>
Server	<input type="checkbox"/>
Workstation	<input type="checkbox"/>
Network/Station	<input type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:	
Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input checked="" type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

network efficiency, you will want to run in dedicated mode, of course. Each workstation requires at least 128K.

Solid Software

Like other NetWare-based networks, Quadnet IX will support all versions of MS-DOS and PC-DOS, but not CP/M 86, Concurrent DOS, UNIX, or XENIX. (See "The Novell Solution" in this issue for a review of NetWare.) Almost all standard PC-DOS software runs with few quirks. *WordStar*, *dBASE II*, *1-2-3*, *Framework*, *Multiplan*, and *LAN:Datastore* performed rather quickly and smoothly. In addition, the safeguards against accidental file erasure are more than adequate. According to Quadram, *WordStar* should run well on up to 50 stations simultaneously. Of course, running 50 database programs simultaneously will be slower.

The Quadram documentation mentions an optional electronic mail package called EMS, but doesn't provide any details about it. NetWare itself has a SEND command that will allow users to broadcast messages to everyone on the network or to send them to specific users. The messages will appear on the 25th line (the status line) of the recipient's screen.

An attractive feature of the system arrangement allows the network to remain functional while additional users are added to it. The token will not be lost, since a newcomer will not be admitted to the ring until all connections are in place and power is applied. A new node appearing on the net causes the net to reinitialize immediately. The software passes the token to each node and updates the master token list, which contains the station ID numbers of all active nodes.

The security system in NetWare is more sophisticated than that of any other network reviewed in this issue. It closely resembles the security arrangement implemented in the UNIX operating system and

provides multilevel protection for both users and files.

Knockout Performance

NetWare had no trouble performing any of the benchmark tests, with the exception of running *ProKey* on the workstation/server. The documentation explicitly states that applications making direct calls to hardware or modifying the ROM

An attractive feature of the system arrangement allows the network to remain functional while additional users are added to it.

BIOS interrupt vectors may not run on the server; *ProKey* does both. For this reason, we were unable to run our *LAN:Datastore* transaction test on a server/workstation in any of the networks based on the NetWare operating system.

Quadnet IX boasts one of the fastest transmission speeds using baseband technology. This high transmission rate, combined with the use of token-passing tech-

nology, adds up to significant performance advantages. Token-passing eliminates the need for collision detection and avoidance, both of which can slow the data transmission process. When a station has the token in its possession, it can be assumed that no one else is on the data bus (ring), and transmission can begin immediately.

When operating with a nondedicated server, Quadnet IX topped the performance charts. The four-user configuration really showed no severe diminishing of performance over the single-user and two-user environments, in sharp contrast to most of the other networks tested. This was really amazing, since the PC-XT was doing double duty as both server and workstation. Quadram's board seems to offload almost all networking tasks from the local host processor, except for the actual memory-to-memory transfer of the data.

Easy Installation

Hardware installation is straightforward. You must insert the usual boards into the PC buses and set up a unique station address on each board, reserving address 1 for the server. The Quadram documentation leaves nothing to chance and provides a chart of switch settings for every possible address on the network. It took us about 45 minutes to set up an address for the server, and about 15 minutes per workstation.

Cabling is also a simple task, since Quadram supplies the cable in precut, 20-meter lengths with the connectors in-

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
Quadnet IX	777	109	83

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Missing Links

Finding true multi-user applications to run on a local area network proved more difficult than you might think. But some are on their way.

Those of you who are already using a local area network system have no doubt experienced both the glory and the pain of being among the "avant garde." One day you'll hand your client a typed summary of the meeting 5 minutes before it's over, and the next day you'll lose three files in system crashes. After your system breaks down a few times, and you find out that it's all because you're using single-user applications in a multi-user environment, you'll wonder, as we did: Just what applications have been designed to run on local area networks?

Since we knew of only two applications that were designed specifically for multi-user systems, we began our search much in the spirit of Alice's walk through her Looking Glass garden: "I should see the garden far better," said Alice to herself, "if I could get to the top of that hill." We believed we would find a whole garden of multi-user network applications if only we could get a better perspective.

A casual survey of local computer stores showed that there were plenty of

single-user packages that run on many LANs. Unfortunately, funny things can happen when more than one user tries to edit the same file at the same time. True multi-user packages are designed to handle this and other LAN-specific situations that can cause problems for single-user software. Our local retail computer dealer, who had installed several LANs for his clients, could recommend only three currently available multi-user application packages: Real World Corporation's *Accounting System*, Data Access's *DataFlex* database, and the LAN: *Data-store* database management system from Software Connections, Inc. He added the names of a few other products that "may be out soon."

Next, we talked with a representative of Gateway Financial Systems, a New York-based consulting firm with special expertise in multi-user systems. "Only two packages worth anything are out there right now," we were told: Real World's *Accounting System* and *DataFlex*. Interestingly, both these packages were also recommended at the computer store. (The third package recommended at our store was limited to too few fields, according to the consultant.)

Further research turned up a few more names, such as the multi-user version of *dBASE II*; an accounting series from CYMA/McGraw-Hill that includes accounting packages for vertical markets such as doctors, dentists, and general contractors; and the database and mail programs from Software Connections, Inc. Any normal shopper would have given up by now and returned to the office, ready to face the next challenge of working with what he or she already had. But we stuck to our guns and kept looking, asking around. . . .

Finally, we contacted Novell, Inc., the company responsible for an operating system called NetWare that many different network hardware configurations are able to use. *Zounds!* According to Novell, almost 700 different multi-user packages run on networks using NetWare. Evidently, Novell has worked closely with hundreds of manufacturers, helping them code into Novell operating system hooks. NetWare can be put to use on the company's own Novell/S network system, as well as on 3Com's, Corvus's and Davong's networks (all of which are reviewed in this issue).

Why didn't anyone else know about this plethora of network applications? As it turns out, Novell intends to benchmark the applications and find out how well they work by next year. For the time being, the company recommends only a handful of packages. Among database managers, the favorites include *DataFlex*, *MetaFile* from Sensor-based Systems, and *Uveon's Optimum* database. What about the other 600 or so? We just don't know.

What all this amounts to is that few applications designed and tested for multi-user systems are available. Some software developers are still waiting for

Diane Burns and S. Venit

answers to basic questions—what protocol to code in, for instance—since there is no clearly defined standard. IBM's network is scheduled for release during the first quarter of 1985, and Big Blue just might come out with its own set of applications.

However, a few strong contenders have already emerged to prepare for the big 1985 race for a share of the growing network market. The most favored packages at this time seem to be *DataFlex* and *Real World Accounting System*. But stick around, because one thing's for sure—the market for network applications is growing fast, weeds and roses. It's going to take time, market attention, and the money that goes with it for a wide selection of packages to become available. ■

For more information about the multi-user software and systems mentioned in this article, contact the manufacturers at the following addresses:

Real World Corp., Dover Rd., Willow Hill Bldg., Chichester, NH 03263, (603) 798-5700.

Data Access Corp., 8525 SW 129th Terr., Miami, FL 33156, (305) 238-0012.

Software Connections, Inc., 1800 Wyatt Dr., #17, Santa Clara, CA 95054, (408) 988-3704.

CYMA/McGraw-Hill, 643 Bair Island Rd., #212, Redwood City, CA 94063, (415) 369-2962.

Novell, Inc., 1170 N. Industrial Park Dr., Orem, UT 84057, (801) 226-8202.

Sensor-based Systems, 1701 E. Lake Ave., Chicago, IL 60625, (507) 289-8967.

Uveon Computer Systems, Inc., 899 Logan #111, Denver, CO 80203, (303) 831-7000.

stalled. (However, the cable itself is bulkier than most network cable since it consists of multiple twisted pairs plus a shield, and this could pose a problem for some users.) First, decide where you want each cluster of workstations and lay out the appropriate wire centers with either 4, 8, or 16 taps. Then cable the stars together

In its repackaging, Quadram has vastly improved the original Proteon and Novell documentation.

using the cable appropriate for the distances between PCs and wire centers and between the wire centers themselves.

For distances under 35 meters, the cable supplied with the network is fine. Shielded twisted-pair cable is suitable for lengths of up to 100 meters, and four conductors twinaxial can be used for lengths up to 500 meters. In addition, you can use fiber-optic cable for very long distances (up to 4 kilometers) or in high-noise environments. Standard db-15, 15-pin connectors serve for connections to the wire center and to the network interface boards in the PCs.

Since every node has a repeater on the workstation board, signal degradation owing to distance is minimized. As cable lengths increase, you can also use repeaters instead of lower-loss cable. Using repeaters, there is no limit to cable length. These are not available from Quadram, but you may obtain them from third-party vendors.

An INSTALL batch file works nicely

to install the server software. You can either accept a default configuration, which will set up your hard disk and allocate server memory, or you can be prompted through a question-and-answer session. The second option provides extensive explanations, but the copious detail could intimidate the uninitiated. After answering all the questions, you simply feed the server floppy disks until you run out.

For each workstation, you must create a network boot diskette, which is a simple process. First, you make a copy of the PC boot files disk that comes with the system, and then you generate a simple AUTOEXEC.BAT file that loads either a DOS 1.1 or DOS 2.0 network support module. Quadram IX also supports an optional remote boot of a driveless PC over the network.

Since interrupts, DMA channels, and I/O addresses are all configurable, you should encounter no irresolvable conflicts with other pre-existing boards in your computer.

Documentation and Support

In its repackaging of the Proteon network, Quadram has vastly improved the original Proteon and Novell documentation and combined it into one manual. It has produced a completely new installation guide, which includes an overview of networks and their various topologies, followed by much improved and simplified hardware and software installation explanations. The rest of the manual is based on the standard NetWare documentation from Novell. However, Quadram has reordered the chapters, written new intros for some sections, deleted what it considered unnecessary or redundant information, added helpful hints, and in general done a good job of cleaning up the documentation.

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NETWORK SURVEY

however. Although the Quadram manual is very complete, finding specific information can be an exercise in futility; there is a very long table of contents, but no index. And the documentation reads more like a treatise than a user manual. It has been

The Quadram network shows its thoroughbred origins in minicomputers and process control.

professionally typeset—unlike the Proteon and Novell manuals—but on cheap paper.

Quadram offers hot-line support to dealers and distributors, and occasionally to end users. Although diagnostics are not included with Quadnet IX, they are available by special request for board-level testing (but not for testing the network as a whole). The only real diagnostic tool NetWare supplies is a full set of error codes that the programmer can use for application programs. Novell basically leaves diagnostics up to the hardware vendor.

Quadnet IX is a greyhound in a world of cocker spaniels. A cocker spaniel will take care of your needs and is kind to the kids, but it is never going to set any speed records. The Quadram network shows its thoroughbred origins in minicomputers and process control and has managed to retain its high-quality characteristics while being crossbred with the PC strain. It seems that in a heavy development environment where its higher cost could be justified, Quadnet IX would be a hard system to beat.

PM/16

TeleVideo combined well-made, high-speed hardware with an easy-to-use, powerful operating system to create the impressive yet affordable PM/16.

TeleVideo, well-known for its 8- and 16-bit microcomputers, has launched the Personal Mini (PM/16) system as its entry into the MS-DOS local area network market. The PM/16 uses a dedicated server with a 40-megabyte hard disk and a 740K floppy disk and supports up to 16 workstations. The system runs with InfoShare, which is TeleVideo's custom version of Novell's NetWare operating system. The main difference between PM/16 and Novell's system is that the TeleVideo network is about half the price for similar performance specifications. TeleVideo is also working hard to provide a large assortment of serious business software so that you'll be able to put the system right to work.

Applications

PM/16 has plenty to offer. In addition to letting you share common resources like the server hard disk and printers, it runs multi-user applications so that more than one user can work with a shared file at one time. You can have up to two spooled printers on the system and you can even hook up workstations that have no disk drives of their own. A host of security features is available, including file-level read and write access permission and logon passwords. It even has a utility to recover accidentally deleted files.

The InfoShare network operating system is based on NetWare (see "The Novell Solution" in this issue for more details). MS-DOS and PC-DOS Versions 1.1 and 2.x are currently supported, and support for DOS 3.0 and 3.1 is in the works. You can install multiple versions of DOS with different device drivers on the server and boot separate workstations from the different versions. A third party is working on CP/M Plus, which will allow the TeleVideo 8-bit micros to attach to the network. To the CP/M user, the network will look like one large CP/M system. The SET LOGIN command will automatically determine which search path to use for CP/M users, so that they will only encounter the 8-bit versions of the different programs.

TeleVideo has plans to release two new multi-user products for the PM/16. These are network versions of RM COBOL and MAI BASIC-4 Business BASIC. A large number of accounting and other business applications are already available for these two languages, so these new products should mean a significant increase in the applications available for PM/16.

As effective multi-user software, TeleVideo claims *DataFlex*, *Informa*, *Optimum*, and *LAN:Datastore* all work well. Accounting packages that TeleVideo claims are functional on the network

include *MBSI*, *MAI Accounting*, *Info Design's Accounting*, and *Open Systems*. A company representative stated that in-house testing of 30 or 40 more multi-user packages is in progress. Also, a number of vertical market software packages for education, government, medical, and legal environments are currently available.

Hardware

The TeleVideo PM/16 uses a dedicated file server with its own console, connected in a star topology with the workstations. Up to 16 workstations may be connected to the server, each with its own multiconductor cable. The cable has six pairs of wires, making it much more expensive than most cabling for other networks, but capable of higher data exchange. Transmission speed is rated at 800 Kbits per second, using baseband technology. This speed is one reason for the system's higher price tag per user.

The file server unit contains two separate processors. A 16-bit 80186 chip handles the file management, while an 8-bit Z80A controls communication with the workstations. The server polls each station in turn, and if one needs access to the network, its command is processed. This system is similar to that of a typical mainframe network with a front-end processor that polls intelligent terminals. It is a fairly simple design, which requires less code and processes more data in a given time than other designs.

According to the PM/16 documentation, the maximum distance between the server and a workstation is 450 feet—the length of the longest cable supplied by TeleVideo. Thus, the maximum distance between workstations is 900 feet, if the server is in the middle. Also, an independent manufacturer, Optical Data Systems, has developed a fiber-optic modem that allows workstations to be up to 6,000 feet from the server.

(continued)

Steve Kanzler, Robert Cowart, and Alfred Poor

NETWORK SURVEY

The server has eight ports for workstation connections. (To connect all 16 workstations, you must add an expansion unit, which has an additional eight ports.) The server also has one serial port and one parallel port for shared printers and another

serial port for the system monitor terminal, which maintains the network operations. Whereas TeleVideo offers an attractive terminal with the system, you can use almost any standard ASCII terminal. The other serial port is designed only for use

with a printer or similar peripheral; it can not be used to share a modem.

The server provides shared storage on a 43-megabyte hard disk, plus a 740K 5-inch floppy disk drive. This means a significant amount of data is available for use with the network. If you need more space, you can add another 43-megabyte drive in the expansion unit.

With so much stored data, making backups can become a serious problem. Even using quad-density floppies, it would still take more than 50 floppies to backup the server's entire hard disk. As one possible solution, TeleVideo offers a 17-megabyte tape cartridge drive in a separate unit, which does backup the hard disk using a file-by-file method. At a rate of 2 minutes per megabyte, it could still take 30 minutes per tape, or about 1½ hours for a 45-megabyte backup.

The InfoShare system includes utilities that allow you to make backups not just at the server, but also from a workstation. This means that you could plug a unit into a workstation and back up the entire system. One of the high-capacity systems with removable media (for example, the Bernoulli Box from Iomega, which has 8-inch removable 10-megabyte disk cartridges) could be a flexible and fast archiving system.

The PM/16 works with most IBM-compatible computers as workstations. A minimum of 128K memory is required, and you install a PM Interface Card in each workstation. TeleVideo claims all IBM personal computers (including the AT), the Compaq Portable and Deskpro, the AT&T, the Columbia, the Eagle, and the Corona will all work on the PM.

One nice feature of the network is that it allows many computers to boot off the server's hard disk. You can therefore save money by leaving out the disk drives in the workstations. TeleVideo offers a diskless workstation for this purpose, which sells

LAN FACT FILE:PM/16

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(408) 471-0255

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Dedicated Server \$ 8,995
Cable (per foot) N/A
Connector N/A
Expansion Unit \$4,995 (8 stations)
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Hardware Capabilities

Configurations:
No. Servers 2-16
No. Workstations 1-8
Server Type Dedicated
Memory Min./Max.
Dedicated Server 256/512K
XT Server N/A
Workstation 256/640K

Shared Peripherals Available:

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Parallel Printers ☐
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Modems ☐
RAMdisks ☐
Other Communications ☐
Other ☐

Backup

Vendor-Supplied ☐
Tape ☐
Global? ☐

Network Description

Architecture Star
Type Baseband
Speed 0.8 Mbit/sec.
Server Type Dedicated

Security

Logon ID ☒
File Passwords ☒
File Protection ☒
Record Protection ☒

Diagnostics

Cable ☒
Server ☒
Workstation ☒
Network/Station ☒
Auto Reroute ☐

Software Capabilities

Operating System:
Disk Caching ☒
RAMdisk Support ☒
System Management ☒
Others ☒

Applications:

Electronic Mail ☒
Chat ☐
Utilities ☐
RAMdisk ☒
Other ☒

Print Spooler Features:

Variable Buffer ☒
Disk-based ☒
Change Paper ☒
Unjam ☒
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TeleVideo has also recently announced a 3270 SNA gateway package manufactured for it by Pathway Design. This package will allow up to 15 PCs to communicate with an IBM mainframe. One of the PCs will act as a cluster controller, doing the necessary emulation and translation.

System Software

InfoShare offers the network manager and users a number of tools to make its PM/16 a powerful and yet relatively easy-to-use system. Certain commands can be executed only at the server console, while others can be used at the workstations.

From the server console, the system manager can broadcast messages to users who have logged on, prevent new users from logging on, and log stations off the system. These facilities enable the manager to clear out the system before performing routine maintenance, such as backing up files. The manager can also control the print-spooling functions, such as clearing the spooler, rerouting print tasks from one printer to another, and even "rewinding" a spooled print job so that it may be restarted from a few pages back. This last feature could be especially handy after a paper jam on a long run. The server console can even be used to monitor the use of the network by the various stations. Up to six stations can be tracked at a time, showing the last five files accessed by each.

InfoShare provides many security features. The systems manager assigns a variety of "rights" to system users. These can be at the subdirectory level (which tend to continue in effect throughout subsequent subdirectories) and the file level. A user can have a combination of rights for different subdirectories and files, such as read access, write access, permission to open a file, permission to create new files,

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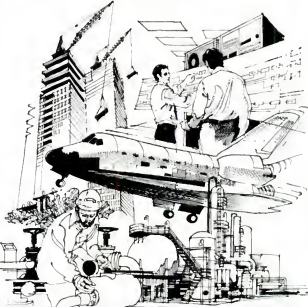
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PC

NETWORK SURVEY

permission to delete a file, and permission to search a directory.

Users also can use a variety of commands. Many commands deal with the many levels of security available, since individual users can control who gets subsequent access to files and subdirectories that they create. Users can also send messages to each other, via an individual workstation, or via all the stations logged on at that time. Although no electronic mail program is currently available, TeleVideo soon plans to announce one.

But many familiar DOS commands cannot be used within InfoShare. The commands BACKUP, RESTORE, PATH, CHDIR (or CD), PRINT, and CHKDSK all have similar options in InfoShare that must be learned instead. While it is not stated explicitly in the manual, it would be wise to remove these command files from the system at the start, they are not invoked inadvertently.

On the other hand, some operations are easier. For example, you can assign up to 26 possible "disks" with the NPATH command. These can refer to different subdirectories within the same drive. This feature makes it possible for you to instantly change to some subdirectory.

For example, the command NPATH L:=SYS.BOB\JAN would create a "disk" L that would, in fact, be the subdirectory \BOB\JAN on the SYS disk (the server disk). Typing L: will take you into the \BOB\JAN subdirectory, without typing a number of CD commands.

InfoShare has sophisticated facilities that permit shared access to files, so that

true multi-user applications can be developed. TeleVideo plans to release a 400-page programmer's manual which promises to be much more extensive than anything Novell presently offers for NetWare. Included with the package will be a floppy disk with all the assembly-level routines needed for taking advantage of the various styles of record and file locking. This should certainly encourage developers of multi-user applications. TeleVideo already has 600 to 800 dealers who have developed their own software under the MMOST 8-bit operating system, and the company hopes that this programmer's manual will assist these developers to convert their programs for InfoShare.

Performance

The PM/16 has a few performance problems. Password menus are confusing, since two separate menus are displayed at the same time, one at the top of the screen and the other at the bottom. This confusion may lead you to select top menu choices while using the bottom menu prompt. The menus can be clearer if they're displayed on separate screens.

A test of the network with the standard applications ran into a few problems. We first tested the 2.40 version of *dBASE II*. It is not copy protected, and we experienced no problems in uploading it to a public volume and loading it. The usual logon message was displayed and we tried to set up a data file using the command:

```
CREATE testfile <Enter>
```

At that point, *dBASE* flashed the error

message "Disk is full" and bumped us back out into DOS. Since the free disk space exceeded 20 megabytes at the time, perhaps *dBASE* was overstating the case. We had similar problems with the multi-user version of *dBASE II*. We then called TeleVideo and Ashton-Tate for assistance. Both provided "patches" that were supposed to take care of the problems, but they did not work. We put *dBASE* aside until we got more help. After two visits by TeleVideo representatives, receiving a new version of the operating system, and more patches, *dBASE* ran smoothly. According to TeleVideo, the necessary patches are now available, so users should not have these problems.

When testing *WordStar*, we tried to find out how the system handled attempts by two or more users to access the same text file for editing simultaneously. Usually, you define such files as unshareable, and the network then flags them as "in use" so that other users get a message that they are denied access to the file. But what happens if someone neglects to mark the file to indicate that others are prevented from sharing it simultaneously? In that case, TeleVideo allows both users to bring up the file for editing and apparently permits both users to save their "version" of the file using the Ctrl-KD command. Upon examining the text files either from DOS or upon re-editing them with *WordStar*, we found that neither user actually was able to save a changed version of the file. InfoShare apparently decides that since both users want the file, and since neither has priority over the other, it will protect all parties by making the file "read only" for all users. Thus, you must flag files properly, or you could lose your revisions without getting an error message.

Installation

We used several workstation PCs on the TeleVideo Personal Mini Network:

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Databases
TeleVideo PM/16	402	101	117

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CIRCLE 277 ON READER SERVICE CARD

NETWORK SURVEY

two IBM PCs, an Ericsson PC, and a TeleVideo diskless PM Workstation. Hardware installation was a snap; we just inserted the PM Interface card into each PC and set the interface switch. The instructions include a drawing that makes switch setting easy. The PM Workstation came with the card installed.

The PM Interface Installation Guide is an extremely well-done manual, one of the best we've seen. Although we did not actually install the interface card into a TeleVideo Tele-PC or Tele-XT, after reviewing the installation manual, we heartily concur with TeleVideo's note, which reads, "... requires major disassembly of the system case. THIS INSTALLATION SHOULD BE DONE BY A QUALIFIED TECHNICIAN."

We set all the workstations to boot from the PM/16 ROM, except the IBM PCs, which had only 64K on the motherboard, and required a ROM upgrade from IBM in order to take advantage of this feature. Later-model PCs with a 256K maximum on the motherboard do not require any modification. Since we used a star configuration, cabling was a simple task. We merely attached one cable from the file server to each workstation. Cables are available from TeleVideo distributors and dealers in fixed lengths from 25 feet up to 450 feet, which is (the maximum distance specified between the workstation and the server).

The only installation problem was configuring the system console. Our system was supplied with a TeleVideo Personal Terminal, a standard item in the PM/16 Starter Kit. This 9-inch screen ASCII terminal has a nicely implemented, screen-oriented setup feature; however, we could not find in the manual the parameters for parity, handshaking protocol, and word length. After some trial and error, we were able to establish communication between the console and the Personal Mini. Tele-

Video assured us that a soon-to-be-released, new manual has corrected this oversight. The system console is required to install the InfoShare operating system onto the server hard disk drive, to configure and monitor the system, and to run utility programs. The system console cannot be used to run application programs.

Serial and parallel printer installation was also simple, and in this case, the documentation supplied default communication parameter settings for the serial printer. These settings can be changed quickly with a configuration program.

We were able to install the operating system on the PM/16 smoothly by following the instruction manual and the Install menu and using the default installation parameters. The software is supplied on three 96-tpi floppies (they have twice the density of IBM PC floppies). We did have one problem during installation that we could have avoided if the documentation had cautioned us. While one member of our team, acting as the system supervisor, was still in the process of setting up the system, other members found that the network was operable and immediately began to load programs and create files. When the installation was complete and users defined with limited access rights, the members found that they could no longer get to some of the programs and files that they had created. It took a while to understand and sort out the chaos that we had created. A note prohibiting users from signing on as anything other than supervisor until the installation is complete would have been helpful. Manufacturers should remember that exuberant users anxious to get on and use a new system need some protection from themselves.

We also ran into a smaller, quirky problem. We chose to assign the names, user1, user2, and so forth, to our workstation users. Later we found that some commands, such as GRANT, which assigns

access rights, would separate the names, with a space between the word *user* and the following number (for example, user1 became user 1). The system would then respond that there was no such user defined. Thus, we suggest that you not use the word *user* in your user names.

This network was one of the easiest to install and was very reliable once it was operating. We found no instances of file corruption or other system trouble. Once the system was installed, it did not require reinstallation as did several other of the networks evaluated in this study. We give it high marks for reliability.

Documentation

The documentation for the PM/16 system comes in two spiral-bound booklets, and though printed with a monospace daisywheel printer, the format is open and easy to read. It has an extensive table of contents in outline form, which is repeated in the second volume. Unfortunately, you have to do a certain amount of flipping back and forth between the two books. Both volumes could be greatly improved simply by adding an index to each.

In general, the documentation is clear and well written, but suffers in some important cases from poor organization. For example, the instructions for hardware and software installation were reasonably good, but were followed by a lengthy discussion of the system security features. These features are extensive and useful, but require understanding and careful preparation to use them effectively. We would have preferred defaults for these options so that we could have proceeded to get the system on line. Most first-time installers of this system prefer to get going, experiment with it, and then make the final decisions on system security.

After the security briefing, we were able to log onto the system as system supervisor and start to set up the user pass-

word and access rights. However, at this point, we ran into problems with documentation errors and inconsistencies between the manual and the actual display screens. TeleVideo has assured us that these problems will be corrected in the next release of its documentation.

Another poorly organized section, in the system manager's manual, is titled, "Defining and Saving System Drive Designations." This section first instructs you to "learn the NPATH and SETLOGIN commands as soon as possible." It then gives some lengthy examples which you can't try since, at this point, the system has not been installed. It would be more useful to walk you through the installation and then provide some demonstration files with which to try out various commands as they are described.

In contrast, the system console commands and user commands sections of the manual are helpful and easy to understand. They provide examples and clarifying remarks at appropriate times. The sections are organized in a typical reference section manner, with the different commands listed in alphabetical order.

Support

TeleVideo covers all hardware with a 6-month warranty, including parts and labor. The company will accept equipment directly from end users, dealers, or distributors. Two third-party repair companies, TRW and Xerox, offer on-site and depot maintenance, and a number of TeleVideo distributors, such as Arrow, which has 15 locations and supplies about 400 dealers, do their own repairs.

Distribution and Pricing

TeleVideo is the primary manufacturer of this equipment, which has been available since June 1984. TeleVideo claims that more than 1,000 systems, with an average of 4.5 nodes/system, have been

shipped to date. Systems are available from 35 large distributors in the United States and 65 international ones. Dealers include Entre, Cybersource, Arrow, Emeritus, and MicroAmerica.

TeleVideo will soon make available two new servers: a less-powerful, less-expensive model, and an upgraded version of the current Personal Mini. In the works is a technique for tying up to eight PMs together into one 256K user system, in which each workstation will have access to any server.

Conclusion

At about \$2,473 per node in a four-user system, the PM/16 is not low-budget. But for about half the price of the Novell dedi-

icated server system, it gives you about the same performance. Another attraction is that you can buy all the parts of the system from TeleVideo, including the PC workstations, which come in various versions: four desktop models, a diskless machine, and two portables. The portable with one floppy disk drive and a network card is only \$2,295, which gives you a complete workstation ready to go. Buying from one vendor helps to eliminate the many hassles that result from incompatibilities and finger pointing.

Although its number of workstations is limited, the PM/16 appears to be a well-made, high-speed hardware unit packaged with the best network operating system we've seen yet.



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CIRCLE 290 ON READER SERVICE CARD

Net/One

The Ungermann-Bass microcomputer network, Net/One offers a wide range of software, including Diskshare, Mailshare, Printshare, and CROSSTALK.

Ungermann-Bass, a well-known supplier of mainframe and minicomputer networks, has now extended its offerings to include a microcomputer-oriented network. Net/One follows the Ethernet protocol at its lowest levels, but it uses the Ungermann-Bass technology for the higher levels.

Net/One is available in either a baseband or broadband configuration. In either case, the primary interface to the network is Ungermann-Bass's Network Interface Unit (NIU) board for the IBM PC, XT, or AT. The NIU is a full-length single card with a 15-pin connector on the rear panel for connection to the network and an LED that is used to indicate a fault condition during normal operation. The NIU has an on-board 80186 to provide the intelligence for the network interface. Ungermann-Bass has indicated that a "dumb" interface card, which will be called the NIC, will be available in the first quarter of 1985; this card should help reduce the high cost of the current system.

Several jumpers on the NIU can adjust such parameters as the port address range, a memory window starting address, a direct memory access request, and the interrupt channel the board uses. These do not need to be changed unless the host PC has more than 512K RAM. This is discussed only in an appendix to the manual;

the main installation guide claims that the jumpers probably don't need adjustment. In these days of ever-greater memory in the average PC, we believe Ungermann-Bass should make the need for rejumping with large-memory computers more prominent.

If a broadband network is being used, a special broadband modem card must be installed as well. The NIU and broadband modem cards are linked together with a short ribbon cable. The broadband modem card has two F-type cable-TV connectors that are used with standard 75-ohm RG-59/U video cable. Ungermann-Bass recommends that you use cable with four shields for improved isolation of radiated or collected RF energy that could corrupt data transmission.

Installing the Network

Actual connection to either the baseband or broadband network is straightforward. Baseband connections are made to a transceiver attached to the network cable. The transceiver gets its power from the NIU and is often installed in air-conditioning vents. Accordingly, the transceiver is subject to fire codes, which helps account for its costs. Interestingly, the Ungermann-Bass baseband system can use either wire or fiber-optic cable for the network itself. Fiber optics offer no particular advantage in a small computer network, but optical cable is ideal for shielded Tem-

pest military applications and can accommodate future bandwidth expansion better than regular cable.

Connecting the NIU board and the transceiver with a 15-pin cable is all that is involved. In a broadband network, two options are available: single cable and dual cable. The first method uses one cable to both send and receive data, while the dual cable configuration is bidirectional. In either case, the necessary cable(s) runs from the broadband modem card to a connection point, called a "multitap."

Making the various connections is very simple, assuming the network cable itself and the necessary transceivers or multitaps have been installed. The actual installation is a plug-in-and-run operation—at least from a hardware point of view.

Configuring the network software is not quite as simple. Nothing is mystical about the many steps that must be taken, but a thorough familiarity with DOS and full understanding of the concept of networking are essential. Ungermann-Bass provides step-by-step instructions, but the lack of explanations of what's going on hinders insight into the processes involved.

Basically, to bring the network up, the installer must get the server station going first, adjust its configuration, and then prepare boot disks for each network station. Once the network is installed, much of the control of network resources is left to the Network Manager—a person who is provided with a set of management utilities that assist him with allocating network resources, such as shared printers and shared hard disks.

The Network Manager can either allow each user to adjust many of his operating parameters or can create turnkey boot disks that do not allow such manipulation. Since the average user doesn't have the expertise to set the necessary parameters, turnkey disks configured by the Manager

Steve Kanzler and Glenn Hart

NETWORK SURVEY

are by far the most likely situation.

Besides setting up the basic configuration and creating the boot disks for each user, the Network Manager can control usage of the hard disks that are attached to the network and control how attached

printers are used across the network. A comprehensive, menu-driven utility, called HDMGR, creates and deletes disk volumes, controls passwords and access to volumes, removes the gaps on the disk left by volume deletion, moves files between

operating systems sharing a hard disk, and so forth. Similarly, printer characteristics, queues, and other printing details are handled by the program PRNMGR.

Overall, the process of setting up and managing both the hardware and software is not very difficult for an experienced microcomputer user and should not present any major problems for the EDP or MIS personnel who might manage Net/One installations. However, the required knowledge and skills are clearly beyond the scope of new PC users, so Ungermann-Bass's assumption that a Network Manager will be available should be taken seriously.

Disk Sharing

The Net/One Diskshare network-server software offers a wide range of features but also has an expensive price tag. The software can incorporate multiple servers with multiple hard disks and provides convenient functions for manipulating the space on the shared disk resources.

Diskshare uses volumes, directories, pathnames, and a working directory, but these terms have special meanings with this network; for example, a Net/One directory is not like a normal DOS directory. A volume is a contiguous area on a hard disk and is designated by a name of up to 16 characters. A Net/One directory is a special form of volume that points to the location of other disk volumes. And, similar to DOS's, Net/One's pathnames and working directories indicate the position of a volume in use on a hierarchical tree.

Volumes must be "mounted" before they can be used. The mounting process forges a network connection between the user's workstation and wherever the data is located on a server station. Each user can have up to six volumes mounted at one time, including the floppy drives at the workstation if desired. The Network Man-

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Hardware Capabilities

Configurations:	
No. Servers	1-unlimited
No. Workstations	1-unlimited
Server Type	XT
Memory Min./Max.	
Dedicated Server	128/640K
XT Server	128/640K
Workstation	192/640K

Shared Peripherals Available:

Serial Printers	<input checked="" type="checkbox"/>
Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Tape	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Bus
Type	Base/Broadband
Speed (base/broad)	10/5 Mbits/sec.
Server Type	XT

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input checked="" type="checkbox"/>
Server	<input checked="" type="checkbox"/>
Workstation	<input checked="" type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input checked="" type="checkbox"/>

Software Capabilities

Operating System:	
Disk Caching	<input checked="" type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input checked="" type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

Variable Buffer	<input checked="" type="checkbox"/>
RAM-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
Queue Reorganization	<input checked="" type="checkbox"/>
Purge Queue	<input checked="" type="checkbox"/>

ager determines whether a given user can choose or change the volumes that are mounted on his workstation by allowing him access to the Boot Options menu; if not, the Network Manager prescreens the volumes for each user and provides a turn-key boot disk instead.

The relatively elaborate security arrangements on Net/One involve boot disks and passwords on multiple levels. You must log onto the system with your own personal boot disks, which are imbedded with your logon ID and password, as well as such system parameters as the amount of memory in your workstation. Once on the network, you may enjoy public access, group access, or private access to particular drives or volumes. Access can consist of no access or read-only, write-only, or read-write access. Certain operations, such as creating or deleting a volume, require write access to both the volume and the next higher level, the directory. Mail volumes are also password protected to discourage violations of privacy. And in some situations, default passwords can be used to minimize typing and inconvenience. Net/One's password provisions are not up to the most stringent standards of the mainframe world but, on the whole, are better than the security provisions of many other microcomputer-oriented networks.

Ungermann-Bass provides a selection of utilities to control the *Diskshare* process. *Diskshare* volumes can be backed up to floppy disks or restored from floppy disk to hard disk. (Note: These are intended for use with DOS 1.1, which has no backup or restore programs of its own; with DOS 2.x, the normal DOS BACKUP and RESTORE commands work fine.) Other programs format floppies or hard disk volumes, copy a floppy disk onto a hard disk or another floppy, compare the contents of two files, mount or dismount volumes, and park the hard disk drive

heads. The various utilities are well done and easy to use.

Electronic Mail

Net/One's *Mailshare* is a well-designed, flexible, and handy program. It provides a rather primitive built-in editor with limited capabilities to write short memos, however, you can also use an

There's no lack of sophistication in Net/One's Printshare program, which practically defies you to think of a spooling task that it would be unable to perform.

external word processor to prepare text to load into the *Mailshare* program. A message that exceeds 60 lines must be transmitted as an enclosure, which is an attachment that can also include any type of data file. Up to ten enclosures can be appended to each letter.

Messages can be addressed to a single recipient, multiple recipients (up to a maximum of 20), or to a distribution list that is predefined by the Network Manager. You can also use the remote mail capability to

direct mail to users on other computer networks via a modem. Net/One has a pleasant, unobtrusive way of informing you that mail has been received, and it allows you, in return, to see whether or not the messages you have sent have been read. Messages are easily saved, printed, and/or purged.

Overall, *Mailshare* works smoothly and well. The only major flaw is the limited text editor; if you're fluent with most word processors, you probably won't mind it, but typical network users will yearn for a more sophisticated editing tool.

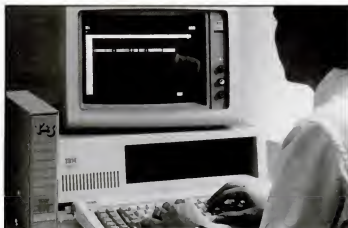
Print Spooling

There's no lack of sophistication in the *Printshare* program, which practically defies you to think of a spooling task that it can't perform. Files can be printed as normal text, which are compressed by the elimination of trailing blanks, or they can be printed as an absolute binary image, which is useful for printing data on plotters or graphics printers. Output can be directed to a default network printer that is specified by the Network Manager, a default user printer, or to another specified printer anywhere on the network.

In addition to displaying your own print queue, you can also display another user's queue, composite queues for individual printers, or all the files that are waiting to be printed on all the printers in the network. In other words, you can minimize the time that is required for completion of the printing task by evaluating which printer has the least backlog and directing your file to it. One of the most attractive features of the print spooler is that it pro-

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
UBI Net/One	542	130	161



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NETWORK SURVEY

vides an estimate of when each file in the print queue will be completed; the estimate is based on the printer's baud rate, which is programmed by the Network Manager. One of the major drawbacks to sharing a printer is the level of unpredictability it

Several aspects of Net/One's screen design and documentation make it's user interface considerably less than exemplary.

imposes, but Net/One's documentation reduces this burden of uncertainty.

At any time, you can cancel the printing of selected files or terminate printing of all your files. If a mishap (such as a printer jam) occurs, the printer picks up where it left off and automatically reprints the beginning of the file again on the assumption that the previous hard copy is probably flawed—a sensible approach to handling the inevitable difficulties with paper handling and printers in general. The Network Manager has further capabilities: he can pause a printer in the middle of a job, restart or abandon a job, and reset the printer. These functions help him to contend with the inevitable hardware problems that printers present.

Communications Capability

Ungermann-Bass offers a specially modified version of the popular *CROSS-TALK* telecommunications software (note that off-the-shelf *CROSSTALK* won't work). This package permits a workstation

Guaranteed

to emulate a terminal and to transfer files across the network. The availability of *CROSSTALK* is an important enhancement that allows microcomputers to communicate with mainframes and minicomputers that are connected to the network. The Net/One version appears to be very similar to the standard *CROSSTALK*, which justifiably has an excellent reputation as perhaps the best modem program available. It is command driven rather than menu driven, but the meanings of its simple two-letter mnemonic commands are indicated on the screen, and excellent on-line help is also available.

User Interface

While Net/One's capabilities are extensive and its operation is smooth, the user interface does not quite meet the standards of the rest of the system. Several aspects of both the screen design and the documentation make it considerably less than exemplary. The Net/One software is something of a patchwork quilt: *Diskshare* and *Printshare* were acquired from Davong, *Mailshare* from Software Connections, and *CROSSTALK* from Microstuf. Unfortunately, Ungermann-Bass has not surmounted the inconsistencies between the individual software elements. Some very distinct differences in the feel and operation of the various programs can lead to discomfort or downright confusion.

The screens are generally legible and intelligible, but differences in appearance make the software seem disjointed. During the software installation, the screen haphazardly flips in and out of reverse video—it looks pretty hokey. Another annoyance is the ugly *Mailshare* logon screen, which demands you press the Return key before the program will do any useful work. Waiting for the display to fill with this ungainly facade every time the electronic mail program is started could become a really irritating part of working

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NETWORK SURVEY

with this network.

However, in other respects, the *Mailshare* user interface is good. For instance, the combination of the message template and the command line enables the program to stand firmly on its own feet—it doesn't require the manual to prop it up. On the other hand, the *Printshare* and the *Disk-*

The Mailshare user interface is good. But the Printshare and Diskshare utilities provide intimidating options that will be beyond the comprehension of many users.

share utilities confront you with an array of intimidating options that will be beyond the comprehension of many users. For example, the general form of the **PRINT** command in *Printshare* is

```
print /?/t/c/m/a/@/*/$  
<filename>
```

A command line might have offered a better way to implement the options than these arbitrary abbreviations. A help screen is available to explain each argument, but it doesn't redeem this quite unfriendly structure.

Overall, *Printshare's* user interface is a generation behind *Mailshare*. This is particularly unfortunate because printing is inherently a time-consuming process, and

a user's spooling mistakes can waste not only his time but the time of other hapless users who are waiting for their turn on the printer.

Documentation

Net/One's documentation is good in some respects and surprisingly unsuccessful in others. Three types of manuals accompany the system: 8½-by-11 printer output manual that documents cable installation procedures (one manual for baseband and another for broadband); a network administrator's user's guide of similar format (stamped "preliminary"); and an IBM-format user's guide. The user's guide is typeset and well laid out, with two colors that are discreetly but advantageously used. The user manual has tab dividers for individual sections, but none of the manuals is indexed.

Ungermann-Bass does a good job of documenting the hardware aspects of Net/One. While they are not handsome, the cabling manuals are thorough and straightforward. The hardware installation procedure for the workstation is presented in the user's guide in a clear step-by-step fashion, with well-emphasized cautions and good illustrations.

The greatest strength of the administrator's manual and the software portion of the user's guide is their accuracy. These manuals may not tell you everything you'd like to know, but they don't often lead you astray. One crucial omission in the version of the administrator's manual that came with the system was corrected in an errata sheet that accompanied this same manual a week later: a clear indication of the documentation team's attentiveness.

In most other areas, the user's guide is far superior to the administrator's guide. But, even though the latter is an early version of a manual that will hopefully be cleaned up, it is nonetheless hampered by crucial deficiencies. The manual focuses

entirely on step-by-step procedures and doesn't include any explanations and guidelines. Net/One gives the Network Manager much greater powers and responsibilities than other users; therefore, the Manager needs a correspondingly greater understanding of the system. Unfortunately, the administrator's guide adds almost nothing to the short description of the network that appears in the user's guide, and

The greatest strength of the administrator's manual and the software portion of the user's guide is their accuracy.

the brief essay on the structure of the shared hard disk and system security is quite insufficient even for a network user, much less a Network Manager.

The administrator's guide provides clear cookbook procedures for a number of necessary tasks. At certain points, the instructions even anticipate what might go wrong and suggest solutions. But procedures must be supplemented by more theoretical material that puts the directions in context and gives meaning to these actions; in this respect, the administrator's guide is a woeful failure.

This manual is equally unsatisfactory as a source of guidance. The Network Manager has to make important choices regarding the allocation of network resources, the degree of autonomy individual users will enjoy, and so forth. And to make sound decisions, the Manager needs information about alternatives and their implications. We believe examples

and models could efficiently present this kind of information, especially if the manual includes a discussion of pros and cons. Here again, the administrator's guide comes up empty.

The Net/One user's guide suffers from similar shortcomings, but this manual has a smaller job to do and its deficiencies are on a lesser scale. What's most puzzling about this manual is the imbalance between the 20 pages that are devoted to describing *Mailshare* (a very friendly program) and the nine sketchy pages that are devoted to *Printshare* (a far less congenial piece of software). We believe these proportions should have been reversed. Tutorials, as well as a summary of commands, would have been a considerable help in this manual. Furthermore, typographical errors are sprinkled throughout the typeset text. And what can you say about a list of error messages where 5 out of 15 messages end with the warning: "No corrective action is possible." Do you consign Net/One to the Computer Swap Meet at this point? We think a good network deserves better documentation.

Future Developments

Ungermann-Bass is not unaware of the lack of consistency among the various software packages. They plan to improve the user interface by providing a more coherent command approach, possibly through a user shell that would supervise the operation of all the other system software.

As this article goes to press, Microsoft has just announced its networking system, MSNET. Ungermann-Bass immediately announced its plans to produce drivers that will make Net/One compatible with MSNET. At a time when IBM has finally clarified its networking plans, the LAN industry seems to be coalescing into a smaller number of distinct camps. The emergence of increasing commonality be-

NETWORK SURVEY

tween systems helps assure current purchasers that their investments will have increased longevity and can only be considered a welcome development.

Net/One is not cheap when compared with similar products. But to remain competitive as network hardware costs decline, Ungermann-Bass has announced the Network Interface Card that was mentioned earlier. This card will significantly reduce the cost of a Net/One node.

Ungermann-Bass has earned an enviable reputation in the mainframe and mini-computer networking arena, but it is somewhat new to microcomputer-oriented networks. Its heavyweight background is manifested in the excellence of its field engineering and support staff and also in the cost of its systems.

Net/One works beautifully in most respects. While improvements are needed in documentation and the user interface, it is

The Net/One is a fine product that should get better with continued development from Ungermann-Bass.

perhaps comforting to work with software from a company with extensive networking experience moving down to the micro-computing environment rather than one that is stretching to move up from small computers to the more demanding world of complex networks. Net/One is a fine product that should get even better with the continued development that Ungermann-Bass will assuredly provide. ■

X-Net

They say you can't be too rich or too thin, but for an LAN product such as X-Net, thinness has advantages and disadvantages.

The operative word for X-Net is "thin." It uses a thin wire to connect the systems in the network, its manual is thin, the price could be described as thin (inexpensive), and the network software has only a thin layer of support. I don't mean to imply that X-Net isn't a good network; for certain installations and applications, it may be all you'll ever need in a network. X-Net is a capable system and probably the least expensive network you can buy. But, the old adage notwithstanding, X-Net isn't as easy to install or use as its thin manual and software-command list imply.

X-Net Functions

X-Net is a fully distributed, "peer" network—it doesn't use a dedicated PC or specialized machine as a file server or network controller. One machine in an X-Net system holds a diskette with a security file containing the user passwords, but otherwise every station in the network is equal to every other station in capability and function. The operator of any PC on the network can use the disk drives, printer, or

RS-232C serial device of any other station on the system. The network software used in a particular station can be adjusted to control which drives and devices from that station are available through the network. The software allows you to make particular files unavailable to the network, but otherwise all of the disk and peripheral resources of every computer on the network are available to any station.

With proper application software, X-Net can provide multi-user access to a file and can regulate the access to individual records in that file. The X-Net literature says applications software written for the PCnet system will work on X-Net, so some applications software is available.

The X-Net software allows you to call for and run a program residing on any disk drive in the network, but it allows only one user at a time to access a given file. The network software has some capability to keep more than one user from writing to a file at a time, but the major responsibility for file sharing is placed on the applications software. Unfortunately, X-Net comes with no applications software other

THROUGHPUT TIMES (in seconds)

Hardware/ Software	Development	Productivity	LAN: Datastore
X-Comp X-Net	693	184	N/A

Frank J. Derfler, Jr.

than the initialization program and the files needed to establish basic network functions, such as security and printing. The network software does not give you any ability to chat between users, send electronic mail, create a print queue, or perform other functions considered part of modern network operations.

Hardware

The X-Net system hardware is quite simple. You merely slip a circuit card into a full-size expansion slot (not an XT short slot) in a PC or compatible and connect the cards in the networked computers with a single pair of wires. This pair of wires forms a bus operating at 2.5 megabits per second. The maximum cable length between nodes is 600 feet, but the manufacturer markets a repeater that can regenerate and retransmit the signal in 600-foot increments. The company claims to have strung PCs and repeaters together in a 10,000-foot system without degradation. The installation kit doesn't include any sort of a wall-mounted socket for connection to the network; the network wires go into and out of the card in each PC. If you have to remove a machine from the network, you can easily plug the cables together so that machines further down the bus are not isolated.

The X-Net program files must always reside in one drive of every PC on the system. Since the program disk is nearly full, this means you effectively lose the use of one drive on every networked PC that doesn't have a hard disk. In some applications this can be a significant drawback, but it isn't too bad if one or more hard disk systems are available for sharing on the network. Another alternative is to invest in a PROM chip containing the network software. This chip can be inserted into the PC, and the software can run from the PROM instead of tying up a disk drive.

(continued)

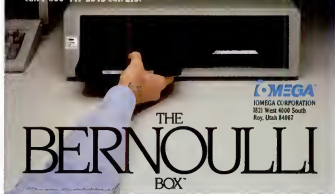
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XComp recommends that computers assigned to the network have a minimum of 256K RAM. This provides some useful RAM space beyond what's consumed by the networking software.

XComp has announced a hardware

add-on product for the IBM PCjr that allows it to enter an X-Net network; it includes a parallel port and has room for a hard disk controller and additional memory.

Software

The X-Net system software is "thin-est" in the area of network control and reporting. The software generates no real report of network status, and nothing tells you about the number of message transmission tries and failures on the network. A menu describing the computer systems on the network and their available peripheral devices would have been useful.

Each network station operator has only a handful of commands to use, but the X-Net program does allow the person setting up the network to create strings of multicharacter commands. These command strings can be sent by pressing a single key, making it easy for an inexperienced operator to access a disk drive or printer that's hooked up to any computer in the network. The network software would be very cumbersome to use without this macro capability, but this heavy reliance on specially created and stored strings means that a lot of work must be done by the person who sets up the network. It also means that you need a programmer to make even minor changes in the network configuration.

X-Net reliably and quickly copies files and sends copy to a printer attached to another computer in the network. But if several stations try to access the same disk drive or printer at the same time, a DOS error message will appear on the screen of one or more of the computers, asking if you want to abort, ignore, or retry the action. Since the network software does not buffer or queue requests, DOS treats requests to use a busy device as errors. The options offered by the DOS error message are fairly clear, but the message is still intimidating and frustrating to anyone who receives it without explanation.

The network software can't send even short messages between network stations, so it isn't possible to use the network to ask if a printer is busy or to notify stations on

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Shared Peripherals Available:

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Parallel Printers	<input checked="" type="checkbox"/>
Plotters	<input checked="" type="checkbox"/>
Hard Disk	<input checked="" type="checkbox"/>
Tape Drive	<input checked="" type="checkbox"/>
Other Mass Storage	<input checked="" type="checkbox"/>
Modems	<input checked="" type="checkbox"/>
RAMdisks	<input checked="" type="checkbox"/>
Other Communications	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Backup

Vendor-Supplied	<input checked="" type="checkbox"/>
Disk	<input checked="" type="checkbox"/>
Global?	<input checked="" type="checkbox"/>

Network Description

Architecture	Bus
Type	Baseband
Speed	2.5 Mbits/sec.
Server Type	XT

Security

Logon ID	<input checked="" type="checkbox"/>
File Passwords	<input checked="" type="checkbox"/>
File Protection	<input checked="" type="checkbox"/>
Record Protection	<input checked="" type="checkbox"/>

Diagnostics

Cable	<input type="checkbox"/>
Server	<input type="checkbox"/>
Workstation	<input type="checkbox"/>
Network/Station	<input checked="" type="checkbox"/>
Auto Reroute	<input type="checkbox"/>

Software Capabilities

Operating System:

Disk Caching	<input type="checkbox"/>
RAMdisk Support	<input checked="" type="checkbox"/>
System Management	<input checked="" type="checkbox"/>
Others	<input checked="" type="checkbox"/>

Applications:

Electronic Mail	<input checked="" type="checkbox"/>
Chat	<input checked="" type="checkbox"/>
Utilities	<input checked="" type="checkbox"/>
RAMdisk	<input checked="" type="checkbox"/>
Other	<input checked="" type="checkbox"/>

Print Spooler Features:

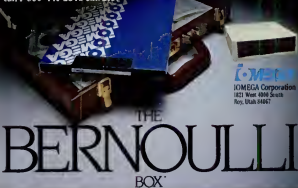
Variable Buffer	<input type="checkbox"/>
Disk-based	<input checked="" type="checkbox"/>
Change Paper	<input checked="" type="checkbox"/>
Unjam	<input checked="" type="checkbox"/>
Printer Commands	<input checked="" type="checkbox"/>
Multiple Copies	<input checked="" type="checkbox"/>
Queue Inquiry	<input checked="" type="checkbox"/>
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the network that an operator wants to make a significant change, such as shutting down and going home. The importance of the ability to send short messages depends on the physical environments of the network. In many instances users can either see or ask if a device is available. In situations where network units are in different rooms or on different floors, however, this limitation can be significant.

Installation

Installing the hardware is fairly simple, but you do have to be careful of possible conflicts between add-on PC hardware and the X-Net hardware. Our *PC Magazine* test system experienced problems between the X-Net controller card and an old Quadram Quadboard. According to XComp, the conflict exists with older add-on memory cards from several manufacturers. The memory cards use an interrupt message that is also used by the network cards—meaning that the network cards can't communicate effectively. Luckily, this is the only installation problem you're likely to run into.

I can't say the same for the software. An XComp spokesman says the company plans to release a menu-driven installation package, which should make things easier. But, given the programs and documentation I evaluated, I would estimate that it would take a person with a good working knowledge of MS-DOS 2.0 3 full work days to set up an X-Net network with just a few stations on it.

X-Net makes good use of the subdirectory capabilities of PC-DOS. Each station on the network sees the network as the Z: drive. Every station on the network is a subdirectory of the Z: drive, and each drive or printer on each station is a further subdirectory. Once you understand the concept, you realize that you can use the DOS change directory command to access any station on the network. By stringing

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together DOS \subdirectory commands, you can manipulate files on any drive and even move files between disk drives on computers other than your own.

This method of operation is fine if you understand the latest versions of DOS, but unsophisticated operators will need a programmer to set up and maintain their network software. The situation is aggravated by the things the documentation doesn't tell you. For instance, the network software creates a subdirectory and then puts a configuration file in it. This configuration file contains information describing the peripherals available to the network, time-out parameters, and other features. But you have to be a dedicated detective to find it. The documentation mentions it only in passing and never makes its purpose clear. This file is important, but you don't know how important until after you find it and put it on the screen.

Documentation

The thin X-Net documentation makes the job of installing and using the network software largely a matter of trial and error. It consists of two manuals, but neither one has an index. Some of the descriptions, such as how to create backup diskettes, are very detailed and well done. But more complex areas, such as how to configure resources available on the network, are poorly explained. In PC's tests, it took two very experienced people the better part of a day to get to the point where they understood enough to begin the configuration process on a simple X-Net system.

The value of X-Net lies in its low price and in its ability to quickly move files through the network. It is a relatively inexpensive way to allow several PCs to share a hard disk drive. Improved documentation would make the system easier to install, but reliance on personalized, complex stored strings of characters means that you must have a programmer around to

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Try a Door, Not a Window

Here's a handy program that lets you use your color and monochrome displays together, as coordinated windows.

While new window programs proliferate on the PC software scene, they often do not display all the information you need to see. If you're working on a large document, program, or spreadsheet, even the 2,000 characters of the PC's full screen may not provide enough viewing space, and dividing it among multiple windows may reduce, rather than expand, the amount of useful information. What you need at such times is something more like the size of a door, which is what the program presented here gives you.

DOORS requires you to have two screens attached to your system and allows you to display data on both simultaneously. The IBM PC readily supports both a monochrome and a color graphics monitor, so if you're lucky enough to have both installed, DOORS may be useful. The program may not run on your "compatible" computer, however.

Through its mode command, PC-DOS (versions 2.0 and later) allows you to switch between two screens with relative ease. However, if you want to save the data on one screen when you start using the other, you are usually out of luck. The trouble is that you have to leave your program in order to invoke MODE.COM, and this often clears the screen you were using previously.

DOORS provides a more satisfactory

1985/no. 3



procedure by letting you switch screens at any time without leaving the program you're currently using. It is a resident program that watches your keystrokes go by, and, when it finds you pressing the Alt key and the Right Shift key at the same time, it runs a program to do exactly what the PC-DOS MODE command does when it switches screens. As an added bonus, DOORS begins by copying the screen you're leaving to the new monitor. DOORS doesn't care which screen you start from—it always switches to the other one—so you can flip back and forth simply by pressing the Alt-Right Shift key combination repeatedly.

Resident programs are usually written

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PROGRAMMING

in assembly language, and DOORS is no exception. If you don't want to get involved in assembly programming, I've provided a BASIC program (Figure 1) that will load DOORS into a COM file for you. If you type it in correctly, the command will run exactly the same. (Theoretically, DOORS can be typed in with DEBUG's Assemble command, but it's doubtful that you'll get it right.)

Stepping through the program isn't particularly hard, and if you're new to writing assembly language code for the PC, DOORS is a good program with which to learn some new techniques. It's a good idea to refer to the ROM BIOS listings in the IBM PC *Technical Reference* manual as you begin to work with DOORS. The interrupts and data areas used by the program are the same for the IBM PC, XT, and AT, so it doesn't matter which edition of the manual you use.

The source listing for DOORS, shown in Figure 2, has comments to tell you what's going on in each instruction, and I'll elaborate further on the program flow here. Don't forget to include the comments if you type the program in yourself—it's amazing how quickly an assembler program can lose its clarity only days after it's debugged and working!

The Keyboard Interrupt

The first thing DOORS does is to replace the ROM BIOS keyboard interrupt routine (9H) that is called each time a key is pressed. This doesn't cause too many complications, however, since DOORS continues to use the original BIOS program to actually read and interpret the keyboard. The VECTORS data segment at the start of the program employs a double word label called (KB_INT_VECTOR) to define the location (usually called a vector or pointer) of the original keyboard interrupt.

If you scan a little further down the listing, you'll find a double word memory location called ROM_KB_INT. That's where DOORS stores the location of the original BIOS keyboard interrupt code so

```

100 GRAND.TOTAL.# = 0
110 OPEN "DOORS.COM" AS #1 LEN=1
120 FIELD #1, 1 AS DOORS.BYTE.#
130 FOR I.N = 1 TO 178
140   READ DOORS.DATA.#
150   GRAND.TOTAL.# = GRAND.TOTAL.# + DOORS.DATA.#
160   LSET DOORS.BYTE.# = CHR$(DOORS.DATA.#)
170   PUT #1
180   PRINT USING "#####"; GRAND.TOTAL.#;
190 NEXT I.#
200 READ THE.TOTAL.#
210 IF THE.TOTAL.# <> GRAND.TOTAL.# THEN PRINT CHR$(7):
PRINT "***Error - Total incorrect!" :
PRINT "***Check Data Statements and Re-run the program."
220 CLOSE #1
230 END
240 DATA 233, 138, 0, 0, 0, 0, 0, 30, 6, 80
250 DATA 83, 81, 82, 86, 87, 156, 46, 255, 30, 3
260 DATA 1, 184, 64, 0, 142, 216, 160, 23, 0, 36
270 DATA 9, 60, 9, 117, 97, 180, 15, 205, 16, 60
280 DATA 7, 116, 11, 60, 3, 118, 3, 235, 83, 144
290 DATA 60, 1, 118, 78, 180, 3, 183, 0, 205, 16
300 DATA 139, 30, 16, 0, 139, 203, 129, 225, 48, 0
310 DATA 51, 217, 129, 203, 32, 0, 176, 3, 131, 249
320 DATA 48, 116, 6, 129, 203, 48, 0, 176, 7, 137
330 DATA 30, 16, 0, 50, 228, 205, 16, 180, 2, 183
340 DATA 0, 205, 16, 184, 0, 176, 142, 192, 184, 0
350 DATA 184, 142, 216, 131, 249, 48, 117, 4, 30, 6
360 DATA 31, 7, 51, 255, 51, 246, 185, 208, 7, 252
370 DATA 243, 165, 95, 94, 90, 89, 91, 88, 7, 31
380 DATA 207, 30, 184, 0, 0, 142, 216, 250, 161, 36
390 DATA 0, 46, 163, 3, 0, 161, 38, 0, 46, 163
400 DATA 5, 1, 199, 6, 36, 0, 7, 1, 140, 14
410 DATA 38, 0, 251, 186, 141, 1, 205, 39, 16143

```

Figure 1: A BASIC program that will generate DOORS.COM.

it can be called to read the keyboard. DOORS will exchange that location with the location of the DOORS_INT procedure, which is the main body of the program. The swapping of the vectors occurs in a small procedure at the end of the program, called SWAP_VECTORS.

When DOORS is loaded, it jumps to the SWAP_VECTORS procedure, changes the vector locations around, and exists with PC-DOS interrupt 27H, which leaves a portion of the program resident in memory. The location of the resident portion is determined by the contents of the DX register at the time when interrupt 27H is invoked. All memory starting at that address can be returned to general use, but everything before it remains resident in memory. SWAP_VECTORS moves its own starting address into DX to tell PC-DOS where to end the resident portion of DOORS.

After you have run DOORS.COM, thus loading the resident program, the procedure called DOORS_INT becomes the

new keyboard interrupt routine. This will be called every time you press any key on your PC's keyboard. The first thing DOORS_INT does is to save all the registers that can be affected within the program. It then calls the original BIOS keyboard interrupt, (ROM_KB_INT). To do this, DOORS_INT pushes the 8088/80286 flags onto the stack before calling ROM_KB_INT, just as if it were an ordinary subroutine. This technique is required because ROM_KB_INT expects to be called as an interrupt, and pushing the flags before calling it as a subroutine simulates that type of call.

The original keyboard interrupt moves the character code of the pressed key into the PC's keyboard buffer and, more importantly for DOORS_INT, it sets the keyboard flags in the KB_FLAG (keyboard flags) byte. This byte is located in the low memory data area reserved by the PC for BIOS data. Its bits indicate which shift keys, including Right and Left Shift, Ctrl and Alt keys, have been pressed.

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(There is more data in this flag and there is also a second keyboard flag, but we can ignore them here.) By isolating bit 0 (the Right Shift key) and bit 3 (the Alt key) DOORS_INT can test to see if they were pressed together. If they were not, the program jumps to the RETURN label, where it pops all the registers it pushed, and simply returns via the IRET instruction.

Time for a Change

If the Alt and Right Shift keys were simultaneously pressed, however, even if still other keys were also pressed, DOORS_INT gets down to the business of switching your PC's screens around.

The first task for DOORS_INT at this point is to determine which screen you are currently using and which mode the screen is in. The possibilities are: the monochrome screen; or the color screen in graphics or text (40- or 80-column) mode. The PC's BIOS video I/O interrupt (10H) provides function 15 to find out, so DOORS_INT loads function number 15 into the AH register and calls interrupt 10H. The current video mode is returned in the AL register.

There are restrictions built into DOORS_INT that prevent you from switching to the monochrome monitor from the color screen when the latter is in graphics mode (AL will contain 4, 5, or 6) or when it is in 40-column text mode (where AL contains 0 or 1). Either of these situations makes it difficult or impossible to copy the color screen to the monochrome screen, so DOORS_INT just jumps to the RETURN label when these modes are active. There are no restrictions on switching from the monochrome screen (AL contains 7) to the color screen.

If the screen is in monochrome or 80-column color text mode, then the screens can be switched. The cursor position is saved so it can be restored at the same location on the new screen. Interrupt 10H is again used for this purpose, this time in conjunction with function number 3, which returns the cursor position in the

```

title DOORS.ASM - Switch Color/Mono Screens On Keyboard Request
;
; VECTORS segment at 0h ; 8088 / 80286 Interrupt Vector Area
; org 9h*4 ; IBM PC Keyboard is Int 9B
; label dword ; Double word label
;
; VECTORS ends
;
; ROM_BIOS_DATA segment at 40h ; Low Memory "BIOS" Parameters
; org 10h ; Location of EQUIP_FLAG
; EQUIP_FLAG dw ? ; Contains video settings
; ; in bits 4 and 5
;
; org 17h ; Location of KB_FLAG
; KB_FLAG db ? ; Contains Alt (bit 3) &
; ; Right Shift (bit 0) Status
;
; ROM_BIOS_DATA ends
;
; ; Initialisation Routine
;
; CODE_SEG segment
; assume cs:CODE_SEG
; org 100h ; COM program format
; BEGIN: jmp $MAP_VECTORS ; Initialises vectors and attach to DOS
;
; ROM_KB_INT dd ; Double word to save address of
; ; ROM-BIOS keyboard interrupt
;
; DOORS_INT intercepts the keyboard interrupt and switches
; ; screens if [Alt]-[Right Shift] combination is pressed
;
; DOORS_INT proc near
; assume ds:nothing ; Push all effected registers
; push ds
; push es
; push ex
; push hx
; push cx
; push dx
; push si
; push di
;
; pushf ; Push Flags for fake interrupt call
; call ROM_KB_INT ; to BIOS program to read keyboard
;
; assume ds:ROM_BIOS_DATA ; Define data segment to read
;
; mov ax,ROM_BIOS_DATA ; keyboard flag & equipment flag
; mov ds,ax
; mov al,KB_FLAG ; Get keyboard flag
; and al,09h ; Isolate [Alt] + [Right Shift]
; cmp al,09h ; Are they pressed?
; jne RETURN ; No, quit
;
; ; [Alt] + [Right Shift] are pressed -- Continue processing
; ; Check on video mode - quit if not monochrome, color 80a25 or BW 80a25
;
; mov ah,15 ; Call Func 15 of Int 10h to
; int 10h ; get video state of the PC
; cmp al,7 ; Is screen monochrome?
; je SCREEN_OKAY ; Yes, go switch screens
; cmp al,3 ; Is screen color test?
; jne CHECK_40_OR_80 ; Yes, go check for 80 or 40 char
; jmp RETURN ; Screen is in graphics mode, quit
;
; CHECK_40_OR_80:
; cmp al,1 ; Is screen 40-character?
; jne RETURN ; Yes, quit
;
; SCREEN_OKAY:
; ; Save the current cursor position
;
; mov ah,3 ; Call Func 3 of Int 10H
; mov bh,0 ; to read cursor position
; int 10h ; (page zero for color screen)
;
; ; Screen switch routine - Establish calling argument (AL) for Int 10h
;
; mov bx,EQUIP_FLAG ; Current equipment flag to BX
; mov cx,bx ; Make a copy of it in CX

```

(continues)

Figure 2: The assembly language program for DOORS.COM.

PROGRAMMING

DX register. The DX register is not disturbed after this and can be used later in the program to restore the cursor, through the use of function number 2.

Completing the Video I/O Switch

While IBM designed the PC to accommodate either or both types of monitor, the company didn't provide a complete function in the video I/O interrupt to switch between them. Function number 0 of interrupt 10H can be used to switch modes, but it does only half the job. All video parameters and ports are correctly set and the screen is cleared, but the PC's Equipment Flag word (which, among other things, indicates which screen is active) is not changed. Interrupt 10H doesn't change the flag because it was designed to be called only by the PC's initialization routine. The video mode set at turn-on is determined by the Equipment Flag which, in turn, is set by the PC's system board DIP switches. (The video mode is the only switch setting on the AT's system board.)

As a result, the Equipment Flag (a data word called EQUIP_FLAG in low memory) must also be changed in order to complete the job of switching screens. Bits 4 and 5 of EQUIP_FLAG determine the type of screen currently active. The copy of EQUIP_FLAG in the BX and the AL registers is modified to tell interrupt 10H the mode to which you will switch in the next block of code. When everything's set, the code at label SET_MODE moves the BX register to EQUIP_FLAG and calls interrupt 10H to finish the screen-switching job.

Cursors, Found Again

There are two tasks remaining for DOORS_INT before its work is done. First, the cursor has to be located on the new screen—otherwise there wouldn't be a cursor on it after the switch. DOORS_INT uses function 2 of interrupt 10H to position the cursor at the location previously saved in the DX register. Interrupt 10H can also be used by applications

```

and cs,30h          ; Extract screen information
xor bx,cx            ; Erase current screen information in BX
or bx,20h            ; Set SX to color 80x25
al,3                 ; Set AL for color 80x25 in Int 10h
cmp cs,30h           ; Is current mono?
jz SET_MODE          ; Yes, switch to color
or bx,30h            ; No, set SX for monochrome
mov al,7             ; Set AL for monochrome in Int 10h
SET_MODE:
mov EQUIP_FLAG,bx    ; Write BX to equipment flag
xor ah,ah            ; Use Func 0 of Int 10h to
int 10h              ; change screen parameters

; Restore Cursor
mov ah,2             ; Use Func 2 of Int 10h to restore
mov bh,0             ; cursor on new screen (position in DX)
int 10h

; After screens are switched, set DS and ES registers to move screen data
mov es,0b000h        ; Load ES with Mono Segment
mov es,es            ; Load DS with Color Segment
mov ds,es
cmp cx,30h           ; Did we switch from mono?
jna COPY_THE_SCREEN  ; Yes, move data from mono to color
push ds              ; No, swap ES and DS to move data
push es              ; from color to mono
pop ds
pop es
COPY_THE_SCREEN:
xor di,di             ; Start at zero offsets
xor cx,cx             ; 2000 chars + attr per screen
mov cx,2000
cld                  ; Make sure move is 'forward'
rep movsb             ; Move words with string instruction

RETURN:
pop di               ; Restore saved registers
pop si
pop dx
pop cx
pop bx
pop es
pop es
iret                 ; Return to system

DOORS_INT endp

; This procedure initializes the new keyboard interrupt vectors
SWAP_VECTORS proc near
assume ds:VECTORS
push ds              ; Save Data Segment
mov es,VECTORS       ; for DOS return
mov ds,es             ; Set up the data
cld                   ; segment for vectors
cli                   ; Disable interrupts
mov es,KB_INT_VECTOR ; Store addresses
mov es,KB_INT_VECTOR[2],es ; of BIOS program
mov es,KB_INT_VECTOR[2],es ; Substitute Our
mov es,KB_INT_VECTOR[2],es ; Program
mov es,KB_INT_VECTOR[2],es ; Enable interrupts
mov es,KB_INT_VECTOR[2],es ; End of new resident
mov es,KB_INT_VECTOR[2],es ; program
mov es,KB_INT_VECTOR[2],es ; Terminate resident

int 27h
endp
CODE_SEG ends
and BEGIN
;

```

(Figure 2 ends)

programs to set cursor height, but if the program you are running did not so use it, the interrupt will not know the correct size (and there's no way to find out). As a result, the cursor may look somewhat dif-

ferent when it gets to the new screen, but at least it will be in the right place.

The last job for DOORS.COM is to copy the data from the old to the new screen. The 8088/80286 string move

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instructions make this easy. These instructions are very efficient at moving large blocks of data in memory because you save program steps by not being forced to use registers directly. All you have to do is point to the source location using the DS (data segment) register, paired with the SI (source index) register, and to the target location using ES (extra data segment) register, paired with the DI (destination index) register.

DOORS_INT sets the source and target to be the PC's two screen buffers. The program initially sets DS to the address of the color monitor buffer and ES to the monochrome screen's buffer. If the screen switch went from monochrome to color, it swaps the two segment registers by pushing them onto the stack and popping them in reverse order. The SI and DI registers are set to zero to start the data movement at the beginning of each buffer.

Each attribute-character byte pair in the screen buffer can be treated as a word, so **DOORS_INT** uses the **MOVSW** instruction (the W stands for word in the instruction mnemonic). The **REP** prefix is used with **MOVSW** to cause it to move a number of words, as determined by the contents of the CX register. **DOORS_INT** sets the CX register to 2,000, the number of words in each screen buffer. One minor, but important, detail is to set the direction to move data in the forward direction (the **CLD** instruction) before **MOVSW** is invoked.

And that's it. **DOORS_INT** flows naturally to the same exit code at the **RETURN** label that was used in other parts of the program.

To implement the program, you should first assemble it using the **ASM** (small) or **MASM** (large) assembler. Then link-edit it with the **PC-DOS LINK** command and convert it to a **.COM** format program using the **EXEBIN** program. Once that's successfully done, initialize it by typing **DOORS** and try switching screens with the **Alt-Right Shift** key combination.

Don't initialize **DOORS** more than once. (Invoking it in your **AUTOEXEC**

EC.BAT file is a good idea.) It will stay resident until you reboot or switch your system off. If there are problems, you'll have to reboot your system to remove the resident code and reinstall the fixed version of the program.

I have found that most programs work well with **DOORS**, and it can be a tremendous help when learning a new program.

Help screens can be copied onto your other screen and left there to continue helping you.

Help screens, for example, can be copied onto your other screen and left there to continue helping you learn the program while using the original screen. Ironically, most of the new windowing systems don't have help windows!

Incompatibilities

A few words of caution about using **DOORS** are in order. Some programs use alternate means to establish the cursor shape, and the cursor will not look right after switching until your program re-establishes the cursor size (the **BASIC** interpreter is a good example). Others have their own screen drivers that insist on going back to the original screen you were on originally, regardless of what **DOORS** does (Lotus's **1-2-3** and **WordProof** are examples). In these cases you'll usually get a copy of the original screen on the target screen, but your program activity won't stay there. And finally, a few other programs have their own keyboard interrupts and so won't allow **DOORS** to operate at all (**XyWrite-II** comes to mind). None of these annoying quirks affects the majority of programs, however, and as you learn how to use **DOORS** with your favorite applications, you'll find it a useful tool for your PC.

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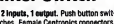


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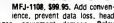
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User-to-User

PC readers use this forum to help one another by passing along their questions, solutions, comments, and complaints.



Subdirectory Fixer II

Several issues ago, *User-to-User* published a trick using *TREE.COM*, *TREEFIX.BAT*, and *TREEFIX.BAS* to locate files across subdirectories. While the *TREEFIX* trio works—and provides information that DOS does not—the *FINDFILE.BAT* batch file in Figure 1 provides an easier way to find a file buried deep inside one of your long-forgotten subdirectories.

FINDFILE relies on a little-used feature of *CHKDSK.COM*, the *IV* option. The DOS manual is a bit murky on *CHKDSK*, and most users don't do much more with this command than see how much space is left on their disks. The *IV* option lists all files in all subdirectories, but you wouldn't know this from the DOS 2.0 manual, which states simply that this

parameter will make *CHKDSK* "display a series of messages indicating its progress, and provide more detailed information about the errors it finds." The DOS 3.0 manual is far more helpful both in explaining the many features of the powerful *CHKDSK.COM* command and for other matters in general.

The *IV* option makes it a snap to search for a particular file. *FINDFILE.BAT* first makes sure you have *CHKDSK.COM*, *FIND.EXE*, and *MORE.COM* on your disk. If you're *PATHing* to a subdirectory that contains these three files, you should leave out the dozen lines beginning with the second one ("If exist chkdsk.com. . .") and ending with "C:". *FINDFILE* then redirects *CHKDSK IV* into a file and uses the *FIND* filter (and the *MORE* filter if appropriate) to locate the file in question.

If you wanted to search for *BASICA.COM*, for instance, you would simply type

FINDFILE BASICA

If you typed

FINDFILE BASIC

the batch file would locate both *BASIC.COM* and *BASICA.COM*, and any other filename with the capital letters *BASIC* in it. You may also use parts of names. Typing

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USER-TO-USER

```
echo off
if exist chkdsk.com goto A
echo put CHKDSK.COM on your disk
goto D
:A
if exist find.exe goto B
echo put FIND.EXE on your disk
goto D
:B
if exist more.com goto C
echo put MORE.COM on your disk
goto D
:C
echo NOW SEARCHING DIRECTORIES FOR "X1"
chkdsk /v>-----
find "X1" ----- | more
del -----
:D
ren ... DONE
```

Figure 1: FINDFILE.BAT batch file to locate specific files across all the subdirectories on your disk.

FINDFILE ASICA

would find BASICA.COM. This comes in handy if you want to look for files with the same extensions. Typing

FINDFILE.COM

will list all your .COM files. Remember to enter capital letters only. And don't put quotation marks around the filenames or parts of filenames you want to find—the batch file will do this for you automatically. FINDFILE won't display a special message telling you no matches were found if it comes up empty. But this will be obvious when no matches are displayed on your screen.

DOS's batch capability is sensational—I find myself using this small utility more than just about any other.—P.S.

A Real WordStar Find

WordStar users may sometimes want to FIND ("QF"), or FIND AND REPLACE ("QA") the CTRL-P commands such as "PV" and "PT" for subscript and superscript, respectively. While one can not type in the "P" commands directly when answering the "FIND?" and "REPLACE WITH?"

questions, it can be done with the help of the ALT key. Here is how:

1. Hold the ALT key down, then type the 3-digit number, and then release the ALT key.

2. The 3-digit numbers for "PB," "PD," "PS," "PT," "PV," "PX," and "PY" are 130, 132, 147, 148, 150, 152, and 153, respectively.

For example, if you want to find "PTs" and replace them with "PVs," you would simply type

```
'QA
Alt-148
(then hit Enter)
Alt-150
(then hit Enter)
```

Type "QQ" before "QA" if you wish to repeat the replacement. Notice that on the screen the letter P in the "P" commands is not displayed. Also, to find and delete the "P" commands, one can simply hit Return at the question "REPLACE WITH?"

Ta-Chung Lin
Carbondale, IL

The problem of FINDing underlines ("S")

USER-TO-USER

has perplexed WordStar scholars for ages, and this is one of the best fixes we've ever received. Many, many thanks. It's a genuine pleasure to be able to hunt down underlines or replace them with boldface commands. One note, though—when working with the ALT key, use the number pad only—the numbers on the top row of keys won't work with ALT.

Swapping Printers with AST Cards

Legions of AST multifunction card owners use a nifty print spooler program called SuperSpool. Unfortunately, when in-

Make sure both these files are in your current directory along with MODE.COM, BASICA.COM, and SUPERSPL.COM. Enter LPTSWAP and the DOS prompt, and normal printer output will be routed to the LPT2: port. Do it again, and you're back to LPT1:.. One warning: on my machine, it clobbers Sidekick out of business.

Final tip for SuperSpool users: renaming SUPERSPL.COM S.COM makes it a lot faster. It's a heck of a lot easier to type S/P than SUPERSPL/P when you're in a hurry to purge the buffer. If you do it, be sure to change the commands in

```
SUPERSPL/P
SUPERSPL LPT2:
MODE LPT1:
MODE LPT2:
BASICA SWAP
SUPERSPL LPT1:
```

Figure 2: LPTSWAP.BAT batch file to swap printer output from LPT1: to LPT2: when using AST's spooling program.

```
10 DEF SEG = &H40
20 A = PEEK (8): B = PEEK (9)
30 POKE 8, PEEK (10): POKE 9, PEEK (11)
40 POKE 10, A: POKE 11, B
50 SYSTEM
```

Figure 3: BASIC SWAP.BAS program called by LPTSWAP.BAT to swap printer output from LPT1: to LPT2: when using AST's spooling program.

stalled at bootup, it prevents output to any printer but the one you've originally specified. If you've set SuperSpool to send stuff to LPT1:, you're shut out of LPT2:.. What appears from the documentation to be logical solutions to the problem can lead to a total system lockup.

The good folks at AST have now provided us with the solution. I've adapted it to quick-and-easy batch file use. Call the batch file LPTSWAP.BAT and use your text editor to make it look like Figure 2.

Then create the BASIC program in Figure 3, and save it as SWAP.BAS.

LPTSWAP.BAT accordingly.

Stephen Manes
Riverdale, NY

A good tip for the many PC users who now have more than one printer. AST's SUPERSPL gets high marks from many users, and this trick makes it even better.

BSAVE Space Saver

PC Tutor in PC Volume 3 Number 5 contained a short piece on saving and recalling pictures from your screen by using the BASIC BSAVE and BLOAD commands.

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USER-TO-USER

```
100 ' BSAVER -- G. Wright
110 ' -- make screen --
120 SCREEN 0:COLOR 2,0:CLS
130 FOR A=1 TO 24
140 PRINT STRING$(78,78);
150 B=B+1:IF B>7 THEN B=1
160 COLOR B
170 NEXT:LOCATE 1,1
180 ' -- save screen --
190 DEF SEG=&H0000
200 BSAVE "filename",0,&H1000
210 CLS
220 PRINT "Now hit any key"
230 IF INKEY="" THEN 230
240 ' -- load screen --
250 BLOAD "filename"
```

Figure 4: BSAVER.BAS program to save a TEXT screen to your disk and then load it back onto the screen.

However, using the short programs in that article fills your disk very rapidly. I wanted to save a screen without taking up so much disk space and found a way to do this. Instead of saying

```
BSAVE "filename",0,&h4000
```

just use

```
BSAVE "filename",0,&h1000
```

This will store 4,000 bytes rather than the 16,000 specified in the original program. The program in Figure 4 shows how it works.

Charles Wright
Hodgenville, KY

```
120 SCREEN 1,0:CLS
130 FOR A=10 TO 310 STEP 10
140 FOR B=10 TO 190 STEP 10
150 CIRCLE (A,B),0.8 A MOD 3+1
160 NEXT: NEXT
170 REM
```

Figure 5: Patch to BSAVER.BAS in Figure 4 that demonstrates how saving only &h1000 bytes (using BSAVE "filename",0,&h1000) will actually save only 1/4 of a graphics image to the disk. After typing in the program in Figure 4, replace lines 120-170 with the lines below. To save the entire graphics image instead of just 1/4 of it, change line 200 to read: 200 BSAVE "pix",0,&H4000.

It's true that you can save an entire TEXT screen in just 4K bytes, since the PC handles full-width text screens as 2,000 bytes—one for each character (80 columns × 25 rows)—plus an extra byte for each character's attribute (its color and whether or not it's blinking). You can even save 40-width text screens in just 2K. But it takes 16K to store graphics images both in SCREEN 1 and SCREEN 2.

For proof, after typing in the BSAVER.BAS program in Figure 4 (which saves a text screen), change the program by typing in the patch in Figure 5 (which makes BSAVER create and save a graphics screen). All that will be saved is a quarter of the total image. To save the entire 16K graphics image instead of just 1/4 of it, change line 200 to read: 200 BSAVE "pix",0,&H4000.

Patch Patch

James Thompson's patch to GRAPHICS.COM (User-to-User, PC Volume 3 Number 23) is only a partial solution to solving the line feed problem on a Gemini 10X printer. Once the screen has been dumped, the line feed is restored to 32/216, which the Gemini interprets as 36/144. This causes a line feed half again as large as normal. To remedy this, you also enter the DEBUG command

```
--e 0250 18
```

to change the decimal 36 (hex 24) to a decimal 24 (hex 18).

Gary B. Gordon
Woodville, VA

Thanks for the update.

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PC Tutor

RAM Surplus Chips

Q: I own an IBM-XT with two floppy drives and two hard disks in an expansion unit. This XT now has 768K of RAM—128K above the regularly addressable 640K.



How can I regularly address this additional 128K so the full 768K is instantly available upon booting—or preferably earlier, when the XT goes through its diagnostic routine?

If this is not possible, can I convert the extra 128K into a RAMdisk? Is software available to do either or both of these things?

Q. S. Camus
Metro Manila, Philippines

A: IBM's personal computers have an upper limit of 640K of useable memory for a very good reason. In the system's memory organization, the IBM monochrome card is located at 640K and the color/graphics card is located at 672K. Also, there isn't much memory area left above those two cards, since the hard disk driver is located at 800K and BASIC and the ROM BIOS are located at 962K.

You might be able to place 64K of the memory at 864K (0D0000h), but a RAM-

disk program would give you a 64K RAMdisk at best, since it probably couldn't link that chunk of RAM with that in another area of memory. A RAMdisk that size would be hardly worth it.

My suggestion is to try to sell your extra 128K chips. As you can see, there really is no hole available where 128K could fit. In fact, that extra RAM is now overlaying your display adapter's memory. I'm surprised that it hasn't interfered with your displays yet.

By the way, IBM's new Enhanced Graphics Adapter is located at 572K, which will probably bother an awful lot of people who now have PCs with 640K.

Serial Port Switching

Q: I tried the BASIC version of your printer port switching program (see PC, Volume 3 Number 18, page 384) and found it to work as you said.

I have an IBM PC with two asynchronous ports, so I'd like to use a similar switching program to choose between the port used for my plotter and the one used by a modem.

I modified your program to address the BIOS data pointer for the COM ports at 0040:0000 and 0040:0002, switching between hex values 03 and 02.

My program worked fine as far as switching the ports was concerned, but when I attempted to send data to either the plotter or modem while connected to COM2, the keyboard would lock up and I'd have to reboot the PC.

I cannot alter my plotting or communications software to redirect serial output to COM2 because both these programs are compiled. What are the reasons for the keyboard's locking up and the lack of response from the PC?

Gerald Jarmuz
Milwaukee, Wisconsin

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PC TUTOR

A: Switching those 2-byte words (03 and 02) between the two locations should work fine if and only if the plotting and communications programs are using the BIOS routines when transferring data. First of all, make sure you're exchanging each full pair of bytes, not just the single bytes at 0040:0000 and 0040:0002.

Any reasonable communications program for the IBM PC will use interrupts to transfer information. This means that the program won't use the BIOS when receiving a character from the modem. Instead, whenever a character is received, a signal to the computer is generated—the interrupt. This interrupt will activate a background task that reads the character and places it into a buffer.

This interrupt technique should be very familiar to you since it's also the way that keyboard input always works. On the keyboard, this feature is called type-ahead, and it allows you to type during disk accesses or while a program is working. For example, you can type the next DOS command while DIR is generating a list on the screen without losing any characters.

With a modem, that kind of response is essential. Without it, the modem's program would cause the loss of characters whenever you did anything at the same time, such as send information. The PCjr, by the way, doesn't support keyboard and serial interrupts as effectively as the PC; with the PCjr, characters you type while the disk is working get lost.

Given that a communications program uses interrupts for receiving characters, you should find that changing the BIOS pointers around 0040:0000 will, at best, send signals to the right port, but nothing will be received. A worse possibility is that your changes will cause the wrong interrupt routine to be set. This could easily cause the system to lock up when a character is received.

As far as your plotter's software goes, it's not as important for a plotter to have interrupt-driven input/output (I/O), so interrupts aren't as universal here as with communications software. I don't know

which program you're using for plotter output, but some such programs (particularly print spoolers) use interrupts.

I suggest that you always keep the modem on port 1 but try the plotter on port 2. You may find that plotter output works fine there.

The PATH Not Taken

Q: I am a little concerned about the answer you gave about the use of tree structures and the PATH command (see "Subdirectory Directions," PC, Volume 3 Number 20, page 372).

According to the DOS manual and some personnel at IBM's technical assistance center in Boca Raton, the PATH command can only be used to search for files having the extensions of .COM, .EXE, and .BAT. In other words, the PATH commands cannot be used to search for data files. These include all BASIC programs, word processing text files, and spreadsheet data files.

When you try to find a file by its "proper" name, the PATH command causes each directory to be searched three times—once each for .COM, .EXE, and .BAT extensions—before switching to the next directory in the path.

IBM's advice was to set up a root directory containing only the appropriate subdirectories and the files necessary to boot the system. The appropriate subdirectories here would include one containing .COM files, one with .EXE files, one with .BAT files, and an additional subdirectory for each of your applications programs.

The PATH command for such a directory structure would be this:

PATH C:\1\C1\COM\C1\EXE\C1\BAT

IBM advised me not to extend the tree structure any further. I can see various reasons for organizing the hard disk with just two levels—the root directory and its subdirectories. One reason is that each additional subdirectory that you define will use up a minimum of 4,096 bytes of storage. As a result, an elaborate tree

PC TUTOR

structure can waste a significant amount of disk space.

Larry Goss
Evansville, Indiana

A: In that earlier column that you cite, the method I illustrated consisted primarily of single-level directories, as you now suggest. My reasons for this and my style of directory organization, however, were distinctly different from those you described. My main reason for creating a directory or subdirectory isn't to optimize the speed of a file search but to organize the hundreds of files on a hard disk into groups of files that are most frequently used together.

First, I don't think you need to be alarmed by how much disk storage is consumed when you create a subdirectory. On a disk, a subdirectory is treated just like a file. Each does take up 4,096 bytes on a hard disk, but each file also takes up at least 4,096 bytes. The significance of these facts, however, is relative. If your hard disk has at least 10 megabytes of storage, you could create 100 subdirectories without particularly missing the disk capacity that they used up. On a double-sided floppy disk, however, a subdirectory only requires 1,024 bytes. Also, you can change the minimum file size to a smaller amount if you desire.

If IBM itself was truly concerned about disk space being exhausted when numerous subdirectories and files are created, why would it have set up AUTOEXEC.BAT files with only a single character—the letter G—in some of its recent programs? In IBM's case, the reason was to standardize a group of programs to all have the same start-up procedure. The general point is that it's usually worth creating additional subdirectories and files if doing so will contribute to the user's convenience.

Second, I do not recommend that you devote three subdirectories exclusively to .EXE, .COM, and .BAT programs, as you say IBM had suggested. This would be fine if all you do is run those programs,

but otherwise the arrangement seems silly. The purpose of subdirectories is to organize the large number of files available on the hard disk into smaller, logical groups, not to divide files mechanically for no functional reason.

If the only reason for grouping files by their extension names is to save the 5 seconds (at most) required to scan through the subdirectories, you'd do better by not using subdirectories at all. In that case, you wouldn't need to bother with the PATH command either.

Do I use more than one level of subdirectories? Certainly. I usually use the lower levels for files I rarely access. For example, I put the utility programs that came with my non-IBM hard disk into a second-level subdirectory that is contained within my directory of DOS programs. This seemed an appropriate place to keep those hard disk utilities, and I never have trouble finding them.

However, I didn't bother putting this second-level directory into the search path. How often am I going to initialize my hard disk with those programs, anyway? Adding them to the path wouldn't speed things up often enough to be worthwhile. Instead, I save a bit of time when I run DIR, since there are fewer files to examine in the DOS subdirectory and there's one less directory that has to be dealt with at the root level.

In your efforts to speed up file search time, most of the information you're acting on is dependent on undocumented aspects of the DOS 2.0 implementation. Who knows what sequence DOS 3.1 (or 4.0, or 5.0) will use for searching paths? Are you willing to spend time reorganizing your hard disk to adjust to the way later releases might operate so you can save a little search time?

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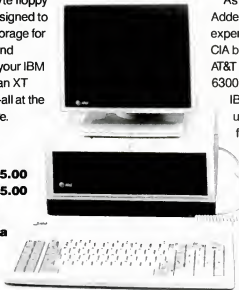
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Real Estate Returns

Real estate offices have their pick of quality software performers. EZ-RE Investor helps individuals evaluate investment options, while DataBroker's forte is keeping a multitude of listings in order.

The typical software needs of a real estate office go far beyond the analysis of information. In the last issue, I reviewed three programs that did just that. (See "Real Investments: Gaining the Edge," PC, Volume 4 Number 2.) Here are two real estate programs with different focuses: a 1-2-3 overlay package and a program for complete office management.

EZ-RE Investor performs fewer tasks than the programs discussed in the last issue but does accomplish its intended functions in a very handy way with the assistance of 1-2-3. A helpful tutorial gets you started.

The program has four basic functions. With *RENTHOUS* you can examine a variety of options for purchasing a single-unit residential property using up to three mortgages. All calculations are made to help you determine the highest



rate of return. The *EQUISHAR* function, similar to *RENTHOUS*, is designed for the investor who is buying a property with the expectation that a tenant will pay all of the expenses. The *INVESTOR* function is a 1-2-3 template that allows you to evaluate just about any real estate investment venture. *MORTGAGE* lets you print out a loan amortized over a period of up to 45 years (and in an impressive format with compressed print).

The overlays are designed to accept modification for any special requirements. Although I didn't receive a manual with my review copy of the software, there were instructions—20 pages of them—that were quite adequate. How-

ever, to use the templates, you must be familiar with 1-2-3.

The *EZ-RE Investor* may not be a huge commercial success, but it is a good package for someone interested in the four areas it covers. The logic of its computations is sound, and the results are first-class.

Getting Organized

Of the five real estate packages I have examined, only *DataBroker* from DataBroker Systems addresses the problems of organizing a real estate office and keeping track of information. This complete real estate management system is capable of working with some popular

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EZ-RE Investor

LB Associates, Inc.
8817 Skokie Lane
Vienna, VA 22180
(703) 938-9093

List Price: \$50

Requires: 256K RAM, Lotus's 1-2-3 (Release 1A), one disk drive, printer.

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word processing programs now on the market and is available in versions designed for single or multiple offices.

Another aspect that sets *DataBroker*

apart from the rest is that its manufacturer will sell you either the software alone or a complete hardware and software package, including a PC-XT.

Like *EZ-RE Investor*, *DataBroker* is divided into four logical areas: Sales Management, General Ledger, Accounts Payable, and Escrow/Trust Accounting. With these modules you can accomplish many useful tasks.

Subprograms let you keep track of the activities of sales associates. Year-to-date figures can be recorded by number, name, office, commissions, units sold, and volume. Sales figures can easily be compared with those of previous years. Detailed reports also provide compar-

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DataBroker is divided into four logical areas:
Sales Management,
General Ledger,
Accounts Payable,
and Escrow/Trust Accounting.

tive analysis of actual sales with sales goals. Commissions can be organized and managed to avoid delays. The system even prints commission checks as well as other types of checks.

The program is slow at points because it must change back and forth between modules; however, there are no really problematic delays. The menus are self-explanatory and well thought out, and the selections have been carefully designed with the user in mind.

Until now, keeping track of listings was a function no real estate software has offered. *DataBroker's* Sales Management module handles the task well. In this area, as in the rest of the program, the reports are impressive and thorough, and the options are plentiful. The information provided includes active listings by territory and price, listings aging report, source of listings report, listings ex-

piration report, summary of office listings and sales, detailed office listings and sales, and source of listings and sales. Furthermore, all this information can be printed out in just about any order, depending on office needs. Such built-in flexibility is a luxury more programs should offer.

The General Ledger and Accounts Payable modules are equally thorough. From invoicing to the balance sheet, a complete set of accounting records can be produced.

Added Attraction

A real plus for *DataBroker* is its Escrow/Trust Accounting module, which maintains and tracks escrow-fund transactions and escrow banking accounts. Reports are compiled by contract number, general ledger number, bank number, or date. Escrow transactions are posted to the *DataBroker* General Ledger system and are reflected in financial statements. Anyone in real estate understands the importance of such records and recognizes the need for absolute control. The *DataBroker* system provides control that would stand up to the most stringent accounting audit.

Because this package is so extensive and complex, it requires much training and effort to use effectively. Taking it one step (or module) at a time is probably the most effective way to introduce *DataBroker* into a real estate office.

As with all such decisions, the choice

of which real estate software to use comes down to personal preference and individual need. Each package reviewed in this two part series can do the job it is

designed to do. Thus, real estate professionals have their choice of several effective, quality software programs geared to meet their business needs. ■

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Pharmaceutical Riches On-Line

The Knowledge Index, while not primarily directed at physicians, has eight useful medical databases, including a full-text pharmaceutical database that is a real gem.

Note: This is the concluding part of a three-part series evaluating services that access on-line medical databases.

Knowledge Index, a less-expensive and easier-to-use subset of Lockheed's huge Dialog database, may not consider the medical market its primary source of customers. However, along with a variety of databases intended for many businesses, Knowledge Index features eight databases designed specifically for the medical profession. Some are extremely useful and offer information unavailable anywhere else.

Three databases contain Medline references for various grouping of years. The fourth is International Pharmaceutical Abstracts. All four of these are found on BRS/Colleague as well as Knowledge Index (see "A 22-Hour Library Card," PC, Volume 3 Number 24). Three more databases that contain biosis previews (research in the biological sciences) for various years may be more valuable to the research-oriented biologist-physician than to the clinician. Drug Information Fulltext, the last database, is the one I found most attractive and is unique to Knowledge Index.

Medline searches are simple and fast. Because Knowledge Index is a promptless system, unlike others, no menus



slow you down. This system makes the search system more difficult for beginners to use, but the necessary commands are not difficult to learn. By following the instructions in a simple-to-understand manual, you can begin using the system quickly.

If You Need Help

If you need more help while on-line, type Help and the name of the database of interest. If you need general advice about the Knowledge Index, then type Help only. After a very brief practice session, you should have no trouble at all. In addition, 2 hours of free service are included in the start-up charge so that while learn-

ing the basics, you needn't worry about the costs of the service.

Lots of Topics

An especially valuable feature of this service is the on-line index of topics you can search for. By entering a few letters, you can tell the system where to start, then you can scroll through the key words until you find the one that most closely suits your needs. This feature helped me avoid some problems I had when performing searches while using BRS and Minet. An example is confusion caused by different spellings of burnout.

Although Knowledge Index searches generally tend to be easier to conduct because of the index, inexplicably to me the service failed to retrieve all the Medline documents I found with BRS. (To see how this service compares to others in my sample searches, see Figure 1.)

A Real Gem

Drug Information Fulltext is the gem of the service. This useful resource contains "the complete text of evaluative monographs from the American Hospital Formulary Service (AHFS) and the *Handbook on Injectable Drugs*, both published by the American Society of Hospital Pharmacists."

From this file, you can extract any in-

MEDICINE

formation you want about a drug—toxicity, chemistry, dosage and administration, drug-to-drug interactions, lab test interference, pharmacokinetics, and

uses. You can find out, for example, whether two drugs administered intravenously will precipitate if given through the same tube, how long a drug remains

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However excellent it may be, the Drug Information Fulltext database requires you to use your native intelligence. If you search for "hypothyroid," you'll get a 2-page summary of the thyroid gland's pharmacology—and 12 other documents warning against the use of certain drugs by the hypothyroid patient. If you put in a request for "migraine," you'll get 42 documents outlining drugs that exacerbate as well as treat that affliction. At times, you are required to be more specific about the aspect of the drug you're interested in by distinguishing, for instance, its toxicity from its general use.

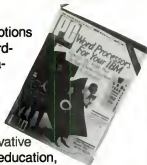
Time Out

Knowledge Index has some limitations, and the most severe is its hours of operation. You can get information at these times: Monday through Thursday, from 6 p.m. to 5 a.m.; Friday, from 6 p.m. to midnight; Saturday, from 8 a.m. to midnight; and Sunday, from 3 p.m. to 5 a.m.; all Eastern Standard Time. If these hours are inconvenient to you, you can subscribe to Dialog instead or to both services. Keep in mind, however, that Dialog is much more expensive and more difficult to learn, and it uses a different set of commands from

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MEDICINE

How Knowledge Index Stacks Up

Service	Search		
	BRS/ Saunders	GTE/ MINET	Knowledge Index
Hematuria and jogging	13	1	8
Burnout and nursing	80	5	22
Diaphragmatic pacemaker	44	3	8

Figure 1: Compared to BRS and GTE, Knowledge Index had moderate success finding data.

those of Knowledge Index. Otherwise, the price is right, the information valuable, and the ease of use more than acceptable.

The on-line database is the best thing to happen to medicine in a long time. If the concept is properly developed, we'll all have improved medical care at lower cost, regardless of where the service takes place.

Each major entity now providing this type of service contains features the others lack: GTE boasts a disease database; BRS, a full-text critical-care library; Knowledge Index, the Drug Information Fulltext. The information is presented in a useful and accessible way. None, however, has yet succeeded in creating a service that fills all relevant needs. But costs are low enough that it's possible to use all these services concurrently. ■

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Technical Bulletin No. 2 in a series.



SUBJECT: Engineering a LAN for Maximum Flexibility.

Quantum Software Systems Ltd. proudly announces QNX 2.0 — the Ultimate Distributed Network Operating System. QNX 2.0 is now available for the IBM-PC, IBM-AT, PC compatibles, DEC Rainbow and TANDY 2000. If you have been waiting for a Real-time Multi-tasking Multi-user Operating system with fourth generation LAN support, then QNX 2.0 can offer you today what the competition can't even begin to promise for the future.

QNX 2.0 integrates the Local Area Network architecture right into the heart of the operating system, at the fundamental level of intertask communication allowing tasks to communicate transparently with other tasks across the whole network. This means that any task (program/application) may access ANY serial port, ANY printer or ANY disk on the network. There are no artificial restrictions. Every PC with a disk is a potential file server. PCs without disks will automatically BOOT over the network.

QNX on the IBM-PC AT:

QNX is the only Multi-tasking Multi-user Operating system available for the AT. It is available in both networked and single machine configurations. At about 2.5 times faster than the QNX 8088 PC based systems, and 10 times faster than other multi-tasking operating systems on the same processor, QNX is the ideal program development environment.

O/S	Computer	Processor	Measured time
QNX™	IBM-PC AT	80286	480 usec
XENIX™	Intel-286	80286	4,930 usec

File Security:

Designed with extensive file security features, QNX 2.0 provides login protection with network wide file permission checking based on 255 groups of 255 users. In addition, each PC user may control network access to devices attached locally to their machine.

Distributed Processing:

The QNX LAN supports distributed processing as well as distributed devices. Tasks may be executed on remote stations as easily as they may be executed on the local work station. This allows pure processing elements (PCs without keyboards or displays) to be plugged into the network to be used as en-

un-committed processing resource. This is ideal for real-time, process control, data acquisition and data communication applications.

Global Communications:

QNX supports a full implementation of X.25 allowing connection to public networks such as Telenet and Datapac. This allows you to link geographically separate LANs together providing true global area networking.

Cost Effective Growth and Flexible Solutions:

QNX is affordable, and will work with the PCs you use today and those you will use tomorrow. You may mix and match different brand PCs on the same QNX network with absolute ease. Multi-user expansion may be accomplished by adding terminals to PCs or PCs to the network. You can start your multi-user application on a single PC with 1 to 10 attached terminals. Once your single processor starts to show signs of degradation, add another PC and connect terminals to the new processor. If the disk becomes the major bottleneck, you may add hard disks to other attached PCs to distribute the processing. Applications which are very CPU intensive may wish to limit a single user to each processor and expand the system with low cost diskless PCs used as work stations. QNX does offer a truly cost effective and flexible solution to your applications needs.

Portability:

QNX 2.0 is portable. The operating system is independent of the physical local area network. It is available in a form suitable for porting to other 8088/8086/80186/80286 computers in the consumer, educational and industrial market place. QNX is ROMable and can operate in as little as 128Kb RAM.

DOS Compatibility:

PC-DOS version 2.1 can run as a task under the QNX 1.2 or 2.0 operating systems. QNX will also allow transparent access to the DOS file system partition end floppies.

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297

Legal Equalizers

PC Law and Advanced Legal Software take over the financial side of office management for small law firms. These programs do the work of the support staffs employed by big-time firms.

Most small law firms have only one or two secretaries and no other support staff, so both the attorneys and their secretaries end up doing data entry when their offices become computerized. As a result, they don't have extra time to learn how to use the computer and software.

For this reason, software aimed at small law firms must be easy to use. A program that offers 1,000 different management reports would be worthless because the attorneys neither need nor have the time to use them. The ideal solution is a basic package that offers time keeping that is integrated with billing, aging of accounts, and invoicing, plus a general ledger that maintains client balances and checkbook balances and also provides a few simple reports.

PC Law by Alumni Computer Group, Ltd., and *Advanced Legal Software*,



PC Law

Alumni Computer Group
1911 Kennedy Rd., #200
Scarborough, Ontario M1P 2L9
(800) 387-9785

List Price: \$1,495

Requires: 196K RAM, hard disk, PC-DOS 2.x.

CIRCLE 793 ON READER SERVICE CARD



from Advanced Legal Software, attempt to meet these criteria. Both offer the basic time-keeping and billing functions that make a computerized system useful to attorneys who generally bill on an hourly basis. However, they differ greatly in their approaches.

The Ultimate Package

PC Law strives to be the ultimate, fully integrated program for the small law firm. It offers time keeping, docket control, client lists, management reports, a tickler (calendar/diary), and a general ledger system. In addition to keeping track of time and easing direct billing through these time records, it pro-

vides all the basic journals and check registers. For example, when you bill a client, the program automatically creates an entry in the accounts receivable program. Payment not only eliminates the accounts receivable but also enters the receipt into the ledger. Besides routine reports, you can also generate profit and loss statements, balance sheets, and amortization tables.

PC Law comes in a standard IBM-size looseleaf binder with two disks. The 152-page manual includes a 45-page tutorial, and although it is sparse on details, it sufficiently covers the main points.

Coded Copying

Although you can duplicate the program disks, the copy-protection scheme requires that you contact the publisher to obtain a code number during the initial setup. This number, which seems to be a combination of your firm name and the program's serial number, is different for each user. And because the firm name appears on most printouts, there is little incentive to make illegal copies.

The system is command driven, but you can press ? to bring up a help screen that gives all possible choices. I liked the help screen but found the editing features restrictive because they are basically limited to the Backspace key. (continued)

Especially valuable features of *PC Law* include its ability to read the date from the system and the integration of the general ledger. Moreover, you can enter

costs as operating expenses or overhead or by referring to particular file numbers. The program also provides for partnership allocation. The tickler system al-

lows up to 700 reminders for appointments, court appearances, or messages.

In spite of its pluses, *PC Law* falls short in its billing system. When you "bill" a file in the main program, an invoice is written to a separate file and given a sequential invoice number. You must run a separate invoice program, which has its own peculiarities, to edit and print the invoice. You also need to remember the invoice numbers that you wish to edit.

The Alumni Group plans to correct most of the billing problems in its next version of *PC Law*. It also plans to give *PC Law* the ability to automatically print periodical statements of certain files.

A Different Approach

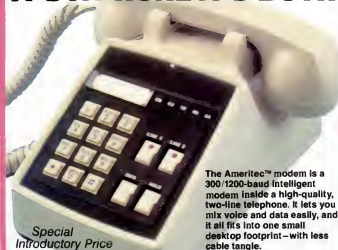
Advanced Legal Software's design is modular: the time-keeping and billing package is separate from the calendar/docket control system and the expanded reports module, even though all the packages work and interface with each other. *ALS* has no general ledger capability, but the manufacturer plans to write separate modules to interface with popular general ledger programs.

Perhaps because of *ALS's* design concentration and modularity, it is more versatile and provides more reports and capacities than *PC Law* in almost every category. For example, *ALS* contains 180 billings codes instead of only 2 per attorney as in *PC Law*, and its maximum number of attorneys is 40, rather than 20. *ALS* has no constraints beyond disk size for clients, time entries, and calendar entries.

The *ALS* documentation discusses accounting and computer systems and describes how to operate the programs, but is too lengthy and confusing.

On the positive side, *ALS* makes excellent reports, provides a valuable demo program, and has the ability to use "noun" and "verb" codes that custom-tailor time entries so you can minimize typing. Of course, you can also make noncoded additions. *PC Law* allows only

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one, not two, code entries in addition to free-form text.

The Posting Process

The *ALS* and *PC Law* billing operations also differ. Although bills can be printed at different times with *ALS*, you are required to "post" the information at the close of a month. Among other things, this process erases the details of your time entries and leaves only balances, clearing disk space for future entries. *PC Law* flags billed records, so they will not appear improperly in future statements, but it does not erase them from the system. You must purge them once you close a file.

Using *ALS* you must run through more menus and questions than with *PC Law*. Although this lengthy process reminds you to change settings and parameters, it can also slow operations. One excellent feature of *ALS* is a warning message that prompts you to turn on the printer before printing begins.

Both *ALS* and *PC Law* have toll-free support lines and very knowledgeable and helpful staffs. Those at the Alumni Group were particularly forthright and helpful.

PC Law is probably the better choice for a solo practitioner because of its straightforward approach, ease of setup and use, and significantly lower cost. However, the program's billing portion needs improvement.

On the other hand, *ALS* offers greater

flexibility and more time-keeping functions but at the expense of a fully integrated, one-write system. In addition, both the costs, attributed to its modular

approach, and the time necessary to learn the system make this program more suitable to a larger firm that can devote more time and resources to it. ■

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Honolulu, HI 96813

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This list is a partial directory of PC user group names and addresses. Use this listing to locate other PC aficionados who congregate in your area or around the world.

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Birmingham Bloomfield IBM PC User Group

c/o Kenneth A.E. Kernen
534 S. Woodward
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c/o R. K. Schmitt
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Kalamazoo, MI 49008
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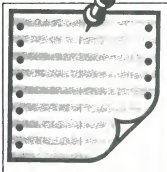
c/o Darrell Frappier
P.O. Box 02426
Detroit, MI 48202
(313) 532-1390

Saginaw Valley IBM-PC Users Group

c/o Barry Kuznicki
Inacom Computer Centers
3580 Bay Road
Saginaw, MI 48603

Grosse Pointe IBM PC Users Group

c/o Michael S. Skaff, Ph.D.
585 Saddle Ln.
Grosse Pointe Woods, MI 48236



Users' Personal Computer Organization

c/o Skip Osterhus
219 Schooner
Lansing, MI 48917
(517) 321-3425

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c/o Jennifer DuPont
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c/o Bill Meeker
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Kansas City, MO 64113
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IBM PC Users Group of St. Louis

c/o Dave Zumbro
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Box 69099
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Princeton, NJ 08553

**The Amateur Computer Group of
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IBM PC Users Group
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512 Chama N.E., Suite C
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Queensborough Community College
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(718) 631-6207

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Users Group**
P.O. Box 28360
Queens Village, NY 11428

**NYPC: The NY IBM Personal
Computer Users Group**
80 Wall St., #614
New York, NY 10005
(212) 533-NYPC

**Hudson Valley Personal
Computing Club**
c/o Jean Barnes
P.O. Box 6057
Kingston, NY 12401

The Manhattan IBM Micro Club
c/o Helaine Head
360 Central Park West
New York, NY 10025
(212) 222-9027

**IBM PC Users Group of the New
York Amateur Computer Club, Inc.**
P.O. Box 106, Church St. Station
New York, NY 10008
(212) 864-4595

The Long Island Computer Assoc.
P.O. Box 280
Commack, NY 11725

**Picture City Personal Computer
Programming Club**
P.O. Box 36
Pittsford, NY 14534

Westchester PC Users' Group
c/o David Hodgson
822 Pines Bridge Rd.
Ossining, NY 10562

BIBMUG
Buffalo IBM-PC User Group
c/o Don Leslie
P.O. Box 1487
Buffalo, NY 14221
(716) 632-1749

**The Northeastern New York
IBM Personal Computer Users Group**
c/o Jim Cummins
5 Jacob St.
Ballston Lake, NY 12019
(518) 399-3016

The Mohawk Valley PC Society
c/o Glenn A. Patton
9 Homestead Road West
Clinton, NY 13323
(315) 724-4331

**New York University
Medical Center Personal
Computer Users Group**
c/o Dr. James Mihalcik, M.D.
Dept. of Anesthesiology
University Hospital
550 First Ave.
New York, NY 10016

NORTH CAROLINA

**IBM-PC Users Club of
Asheville, N.C.**
c/o Richard L. Davis
142 Edwin Place
Asheville, NC 28801
(704) 252-7529

**The Business Computer Club of
Charlotte**
c/o T. Scott Brumley
P.O. Box 26822
Charlotte, NC 28221-6822
(704) 527-0110 (days)
(704) 399-3074 (evenings)

Personal Computer Club of Charlotte
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Charlotte, NC 28211
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New On The Market

HARDWARE

Soft-Touch

A touch-sensitive screen that mounts over the front of the IBM monochrome or Princeton Graphics color monitor, giving the user the ability to input data and respond to screen prompts by touching appropriate areas of a display.

The Soft-Touch device uses an infrared scanning beam arrangement to detect contacts with the screen. The complete system consists of the bezel frame, an interface board that fits a slot in the user's PC, and a connecting cable.

The user can program applications for the Soft-Touch in BASIC or assembly languages.

(List price: Available from the manufacturer)

BFANM Corp.

1704 Moon N.E.

Albuquerque, NM 87112

(505) 292-1212

CIRCLE 677 ON READER
SERVICE CARD

FDC-5150/FDC-5152 Adapters

Two high-performance floppy disk drive adapter cards capable of supporting 8-inch drives, Amlyn, Drivetec, and Kodak high-density drives (2.5- to 2.7-MB formatted storage per disk), Irwin 110/210 streaming tape backup units, and other types of

disk drives. Both cards can read and write to the new 96-track high-density drives, such as those used on the PC AT under PC-DOS 3.0. This capability allows IBM PCs and ATs to share the same high-density disks with appropriate drives.

The FDC-5150 supports data transfer rates of 125K, 250K, and 500K bits per second, allowing it to read/write to either 48-track or 96-track drives. To these rates, the FDC-5152

adds a 300K bits-per-second rate, giving this card the added ability to read and write both 96-track and conventional PC 48-track disks from the same 96-track drive, with only those limitations shared by the PC AT's own adapter, as listed in the PC-DOS 3.0 manual.

The use of either card provides a low-cost method for IBM PC users to obtain PC AT storage capacities. Both cards employ a proprietary switching circuit

that automatically adjusts the clock rate to the one appropriate for the disk in use. The cards allow drive types to be intermixed in any configuration for up to four drives in a single system.

(List Price: FDC-5150, \$125; FDC-5152, \$189.95)

Micro Mainframe

**11285-E Sunrise Gold Cir.
Rancho Cordova, CA 95670
(916) 635-3997**

CIRCLE 658 ON READER
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jr extender, Falcon Technology, Inc.

jr extender

An add-on half-height disk drive for the IBM PCjr. The jr extender drive is enclosed in a cabinet designed to complement the PCjr, which plugs into the expansion panel on the right side of the PCjr. The cabinet's chassis also includes sockets for up to 256K of added RAM and a built-in expansion slot. Also bundled with the jr extender expansion system is the PC-Write word processing system, and an enhanced version of PC-DOS 2.1, allowing the PCjr to run all software for the IBM PC.

(List Price: \$845)

**Falcon Technology, Inc.
6644 S. 196th St., #T-101
Kent, WA 98032
(800) 722-2510
(206) 251-8282**

CIRCLE 676 ON READER
SERVICE CARD

SOFTWARE

MPGRAPH

A compiled BASIC add-on program for *Multiplan*, allowing users to create bar charts and line graphs directly from the output of the spreadsheet system. *MPGRAPH*'s menu enables the user to select either zero base or a relative base for graphic output of *Multiplan*'s symbolic output files. Hard-copy printouts are obtained through PC-DOS 2.0's graphics command.

(List Price: \$79)

Requires: 128K RAM, one disk drive, PC-DOS, *Multiplan*.

Millen Keller Co.
921 W. 6th Ave.
Anchorage, AK 99501
(907) 279-8441

CIRCLE 663 ON READER SERVICE CARD

Construction Management Accounting System

A menu-driven accounting system for construction firms and contractors. The software features project cost-control accounting, as well as general ledger, customer and supplier ledgers, project checklists, and cost-breakdown reports for each project.

Among the software's reports is a Project Status printout that reflects all transactions entered (pur-

chase orders and contracts included), as well as budgets and forecast overruns/savings for each cost breakdown. Entries can be made with automatic verifications and posting to all pertinent ledgers, providing continuously balanced records.

(List Price: \$950)

Requires: 128K RAM, one disk drive, PC-DOS. *Hard Hat Software Ltd.*
3545 Atwater Ave.
Montreal, Quebec
H3H 1Y2 Canada
(514) 931-4471

CIRCLE 689 ON READER SERVICE CARD

Res: The Program Residency Manager

A program to make other programs RAM-resident and to assign character string macros to keys. Up to nine programs can be made concurrently resident; up to 56 keys can be redefined.

The user can configure *Res* with the included *Conres* utility to make a set of programs memory-resident automatically for specific applications. Differently configured copies of *Res* can automatically create integrated multiple-program environments, each with its own set of assigned keyboard macros.

Any applications program can be made memory-resident with the following two exceptions:

- Applications in which the root program uses separate overlay files. In these cases, only the root program is made resident.

- Copy-protected programs that require a specific disk to be in drive A:. To make these programs resident, the proper disk must be in place during initialization.

A version of *Res* is also available without the keyboard macro facility.

(List Price: With macro facility, \$90; without macros, \$60)

Requires: 256K RAM, one disk drive, PC-DOS. *SoftLabs*

400 E. Anderson Ln., #306
Austin, TX 78752

CIRCLE 686 ON READER SERVICE CARD

MicroTutor Productive Application Series

A series of tutorial programs for learning applications such as *WrdStar* and *MultiMate*, as well as the use of the IBM PC, XT, and various versions of PC-DOS. Features of the tutorials include split-screen simulation of the subject application, several user control options, and graphics and animation.

(List Price: \$80-\$95, depending on tutorial)
Requires: 128K RAM, one disk drive, PC-DOS. *Advanced Systems, Inc.*
155 E. Algonquin Rd.
Arlington Hts., IL 60005
(312) 981-1500

CIRCLE 673 ON READER SERVICE CARD


New on the Market Submission Guidelines

1. Please include the retail price, distribution methods, and details of both hardware and software requirements needed for an end-user to properly use your new product. For software especially, this includes required amount of RAM, number and type of disk drives, operating system(s) supported, and any peripheral equipment needed.
2. Releases should be typewritten double-spaced on one side of the paper. Copies of advertisements for the product may be included, but in most instances we need more information about a product than is typically included in an ad.
3. Include telephone contacts for marketing and technical questions.
4. If available, include black-and-white glossy photos of the product, 4 x 5 in. or larger.

Please note that all products are run on a space-available basis. It is impossible to guarantee publication of a product announcement for any particular issue.

Inclusion in *New on the Market* is at the exclusive discretion of the editor.

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CIRCLE 415 ON READER SERVICE CARD

Company Offers FREE OVERNIGHT DELIVERY!!!

New customer service policy expected to set a new standard in the mail order industry!

BY MICHAEL CHRISTOPHER

GARDEN CITY, N.Y.—Mr. David W. Pasternack, President of Logisoft, a major IBM PC software and hardware distributor, has announced the inception of a unique new customer service policy... free overnight courier delivery on their entire product line.

In a recent interview, Mr. Pasternack stated that "We feel our new free overnight delivery service will set a new standard in the computer software mail order industry. In a study we conducted, we found that in addition to competitive pricing, experience was a factor utmost in our customer's minds. Whether their order was \$300 or \$3000, the need to get their package as soon as possible was the same. Under our old procedures, between processing and shipping time, it could take up to a week and a half to two weeks for an order to arrive. With our new courier service, an order can be processed, shipped, and arrive in our customer's hands in only 3 working days... at no additional charge!"

The company is using Emery Worldwide to handle the large number of packages being shipped each evening for next day delivery. "We chose Emery for their competitive pricing structure and excellent delivery record", said Mr. Pasternack. Emery was quoted as saying, "This makes Logisoft the largest single Emery account in the New York Metro area."



LOGICIP OF THE MONTH

Choosing software can be mind-boggling. With the proliferation of publishers, how do you choose. Analyze your needs... what specific tasks do you want to perform. Read the software reviews; an excellent way to evaluate a package. Ask around... you'd be surprised how many associates may be using a package similar to your application. Finally, choose the best package (not always the most expensive). Upgrading will end up costing you more. Remember the key word is research.

TOLL-FREE SUPPORT A Smashing Success

GARDEN CITY, N.Y.—A survey of Logisoft's toll-free technical support policy was done to see if it warranted the continued costs of the 800 toll-free number, personnel costs, etc. After careful monitoring of these calls (both pre-sale and after sale) it was found that 92% of the calls were for legitimate technical support questions rather than for answers already contained in the software's operations manual. As a result of the survey, the decision has been made to continue toll-free support as an important part of their customer service.

This service consists of assisting with:

- Hardware requirements
- Initial boot-up procedures
- Initial software configuration (printers, disc drive, etc.)
- Back-up procedures
- Defective program determination
- Alternative program recommendation
- Return policy

Logisoft's Lowest Price Guarantee Still Effective

GARDEN CITY, N.Y.—Logisoft, Inc. has indicated that their long time policy of guaranteeing the lowest prices in the mail order market is still being offered and will not be affected by their new free overnight delivery service. "We will continue to beat any price by \$10" a company spokesman said. "We'd be crazy to fool with success", he stated; "since the inception of our lowest price guarantee, sales have skyrocketed."

When asked how Logisoft could afford to give their customers free overnight delivery plus beat any price by \$10, they replied "Buying Power". "Very simply", they said, we buy at the best possible prices and pass those savings along to our customers".

CONTINUOUS STATIONERY: BIG BUSINESS, But "Where's The Class?"

NEW YORK—The growth of Logicforms, Inc., a member of the Logic Group, has been phenomenal. Mr. Ralph Corso, President of Logicforms explains why. "Up until now, buying continuous stationery through the mail has been a take what's available situation". "First off", he said, "almost all mail order firms offer only stock letterheads & envelopes with limited typesets, colors and stock logos from which to choose, but, 'where's the class?'"

"The individual style and design of a letterhead", said Mr. Corso, "reflects the professionalism and personality of a company and should not have to change because they now have a printer and the need for continuous stationery. While other mail order firms are limited in the variety they can offer, Logicforms specializes in custom stationery. Logicforms offers a large selection of quality paper, ink colors and special effects such as thermography, blind embossing, foil stamping and multi-color printing." Mr. Corso went on to say that

"whether a customer chooses to supply his own artwork or printed letterhead, or wishes to select from our vast array of stock designs... We are the Logical Choice".

For a free sample/pricing kit and a handy re-usable shipping envelope for artwork, simply call toll-free 1-800-645-3491 or send a sample of your current stationery for a free firm price quote. Mail to Logicforms, Inc., 300 Garden City Plaza, Garden City, N.Y. 11530

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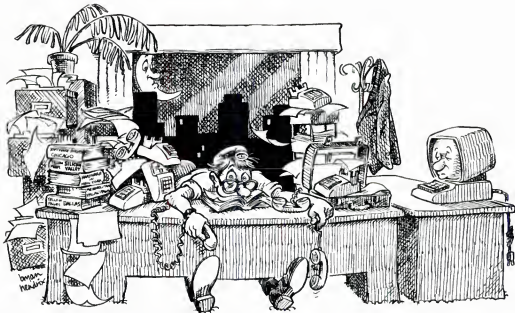
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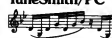
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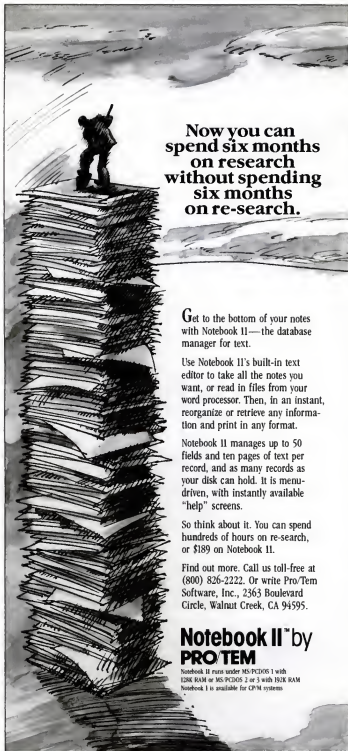
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COMING UP



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B-Tree Structure

Data management packages of many descriptions call themselves B-tree based, and some are—but others aren't. A *Tech Journal* tutorial on B-trees, how they are built, and the advantages and disadvantages of using them begins in the first article in a two-part series on understanding this important tool for building data management packages.

Turbo Pascal

With the advent of Borland's popular Turbo Pascal comes the need for ways to use this powerful tool. *Tech Journal* delves into the subject of extending the power of Turbo Pascal to other programs. Pascal coverage in February also includes a review of another new product from Borland, the Turbo Toolbox, and a how-to piece on accessing the command processor's set environment from IBM Pascal.

Memory Options for PCjr

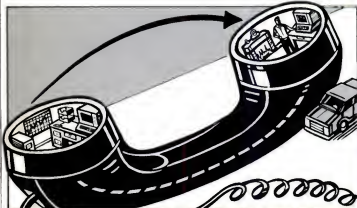
Tech Journal looks at three sidecars that increase Junior's memory with hardware reviews of PC Captain and PC Wave from Tecmar and the IBM Memory Expansion Sidecar.

Communications

Continuing its survey of communications products for the PC, *Tech Journal* presents an in-depth review of Janadon's Hostcomm, a product that allows messages to flow from PC to PC through remote access.

Remote Access With CTTY

The little-known CTTY command is far from useless: It lets you run your PC from another computer's console. Among its other benefits, you need never miss a deadline or a train again.



It's 4:50 p.m. You've got a major report due tomorrow morning at 8:30. You need at least another 3 hours to whip the thing into shape. Trouble is, you have to catch the 5:07 train to Greenwich. All the files you need are on your hard disk, but even if you had time to dump them to a floppy and take them with you, you couldn't use the disk on the Apple IIe you've got at home.

This problem is one for the Thinking Machine, the scientist-hero of some of my favorite childhood storybooks. The author put his character in a box (both literally and figuratively). There seemed to be no way out. But of course the scientist always escaped, usually by using simple

items in a clever way. In this case the Thinking Machine would probably try the CTTY command.

Believe it or not, the CTTY or Change Console command in your DOS 2.x manual could get you out of your box rather easily. In a nutshell, CTTY lets you run your PC from another computer's keyboard (console). To put CTTY to work, you'll need an auto-answer modem connected to your PC, as well as a second communicating computer and modem at some other location. You'll also need a disk with the COMMAND.COM and MODE.COM files, and possibly one or more of the batch and other files discussed below.

The Set-Up

First, make sure your PC's modem is set properly. If you have, for instance, a Hayes Smartmodem, remove the face plate and set Switch 5 to the up position to tell the modem to answer the phone on the first ring. Then set Switch 6 up to disable the modem's automatic assertion of the Carrier Detect signal. The PC doesn't need this signal, and it could cause unforeseen problems later in the procedure. Since most commercial PC communications programs require you to disable Carrier Detect this way, there's a good chance your modem will already be properly set.

Next, create a simple batch file. Key in `COPY CON: REMOTE.BAT` at the DOS prompt, then enter:

```
MODE COM1:300
CTTY COM1
```

Hit F6 to write the file to disk if you're using `COPY CON:`.

As the DOS manual explains, you may specify a variety of communications parameters when initializing the COM1 port with the `MODE` command. If you specify only the baud rate (300 or 1200 when using a modem), the program defaults to 7 data bits, even parity, and 1 stop bit. The parameters you enter will depend on the communications settings

you'll be using on your remote machine. Interestingly, the PC does not seem to care whether the remote system sends it both a carriage return and a line feed or

just a carriage return.

Run this file and flip on your modem before leaving the office. Once you've issued the CTTY COM1 command, the

keyboard will be disabled and nothing else will appear on the screen. To the computer the COM1 Receive Data line is the keyboard, and the Send Data line is the screen. The only way to restore keyboard control is to reboot or send the command CTTY CON into the machine through the communications port.

Now you're at home. You've dialed your office computer, and the PC's modem has picked up the line and made the connection. The first thing you'll see on your screen is the PC-DOS prompt. From that point on, you can change logged drives, call for directories, display text files, redirect them to the PC's printer (with the command TYPE FILENAME.PRN), or enter any other DOS command. (If you're going to be accessing your hard disk or using DOS path names, be sure your remote system can generate a left backslash or otherwise transmit an ASCII 92.)

You can also upload information from your home system to your office PC, and you can download in the opposite direction. You can even run at least some of your IBM programs remotely, specifically those that generate output a line at a time. Those that require sophisticated cursor controls to let you move all over the screen cannot be used.

dBASE by Remote

Fortunately, you can get around this limitation. For example, you may be disappointed to find out that you will not be able to add records conveniently to your dBASE files. But since that program's output is line oriented, you can easily list or print records to the screen of your remote system.

You just have to remember one trick: Run the INSTALL module before trying to run dBASE remotely. When dBASE Version 2.4 is installed for the PC, the program sends its output to the PC's screen, regardless of whether CTTY is in effect. Installing it for the IBM Displaywriter (selection M on Menu #1) solves this problem and sends the output



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to the COM1 port when CTTY is enabled.

Even with complex programs, you're not out of luck. Since the worksheets for such programs are stored as text files, you can transfer them to your remote system. Just key in TYPE FILENAME to display them on your home screen. Save the listing to disk; then hang up and load them into the version of the program that runs on your home system. When you're finished adding data to your spreadsheet at home, you will want to call your office computer again and transmit the updated worksheet text file.

EDLIN.COM is the ideal tool for this purpose. Make sure that the EDLIN text editor is available to your PC; then type EDLIN FILENAME on your remote system's keyboard. When you see the EDLIN asterisk prompt, hit I (for Insert). You'll see 1:* on your screen, at which point the program will be ready to receive text.

You can transmit *VisiCalc* and other text files to EDLIN continuously at 1200 baud with no problems. When the transmission is over, you'll see a line number followed by a colon and an asterisk. At this point, the DOS manual says to hit a Ctrl-Break to get back to the EDLIN command mode. If you're using a non-IBM computer, hit Ctrl-C. When the lone star appears, key in E to end the EDLIN session and write the file to disk.

Signing Off

When you finish your on-line session, you'll have a number of choices. If you simply hang up the phone, the PC's modem will do likewise and then get ready to answer the next call. If you key in CITY CON at your remote terminal, the PC will revert to normal operations and you will no longer be able to reach it via modem. Alternatively, you could tell the PC to run a previously prepared batch file or one that you create on the spot with EDLIN. You might want to have it print out the files you have sent it after you sign off, for example. Or you might or-

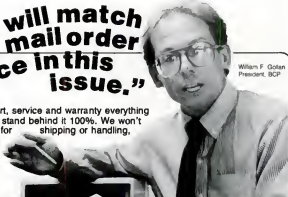
der it to do a long sort.

With the right equipment, CTTY can handle many tasks. If you use it often, consider getting a screen-blanking pro-

gram to minimize the effect of leaving your monitor on all night. A number of these are in the public domain. Contact your local users group or check the IBM

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A Look at Video Boards

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Rags to Riches

Do you own a very small business? If so, you may have balked at the thought of having to deal with a highly structured computer-based accounting system. Now, *Rags to Riches*, a new accounting system, provides a middle ground for very small businesses. Price Waterhouse reviews the package and finds it offers an attractive alternative for some types of business but might be inappropriate for others.

On-Line Oxford English Dictionary

All 17 volumes of the *Oxford English Dictionary* are going on-line to keep up with the technological changes that affect the English language. And IBM is providing much of the financing for the project. The on-line dictionary will not only list and define all the words in the English language but will also provide all the meanings of each word throughout its history and track down its roots. Unfortunately, though, the product probably won't be available until the end of the decade.

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MWC86 gets your C programs running faster and uses less memory space than any other compiler on the market. Then *csd*, Mark Williams' revolutionary C Source Debugger, helps you debug faster. That's The C Programming System from Mark Williams Company.

MWC86

MWC86 is the most highly optimized C compiler available anywhere for the DOS and 8086 environment. The benchmarks prove it! They show MWC86 is unmatched in speed and code density.

MWC86 supports large and small models of compilation, the 8087 math coprocessor and DOS 2.0 pathnames. The compiler features common code elimination, peephole optimization and register variables. It includes the most complete libraries. Unlike its competition, MWC86 supports the full C language including recent extensions such as the Berkeley structure rules, voids, enumerated data types, UNIX* I/O calls and structure assignments.

Quality is why Intel, DEC and Wang chose to distribute MWC86. These industry leaders looked and compared and found Mark Williams to be best.

User Friendly

MWC86 is the easiest to use of all compilers. One command runs all phases from pre-processor to assembler and linker. MWC86 eliminates the need to search for error messages in the back of a manual. All error messages appear on the screen in English.

A recent review of MWC86 in *PC World*, June, 1984, summed it up:

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csd C Source Debugger

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csd C Source Debugger serves as a microscope on the program. Any C expression can be entered and evaluated. With *csd* a programmer can set breakpoints on variables and expressions with full history capability and can single step a program to find bugs. The debugger does not affect either code size or execution time. *csd* features online help instructions; the ability to walk through the stack; the debugging of graphics programs without disturb-

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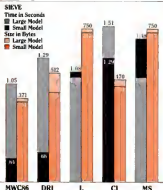
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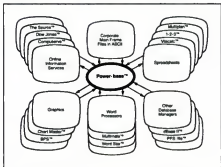
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